

水素分子の各種疾患又は疾患モデルに対する効果を報告した文献

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対象器官 又は疾患	疾患又は疾患モデル	著者及び報告年	使用動物種				投与形態				
			細胞	齧歯類	その他動物	ヒト	培養液	生食	水	ガス	その他
脳	脳梗塞	Ohsawa et al, 2007; Ono et al, 2011; Ji et al, 2011; Liu et al, 2011b; Cui et al, 2014; Zhao et al, 2015	○	○		○	○	○		○	
	脳における活性酸素産生	Sato et al, 2008		○						○	
	拘束で誘発した認知障害	Nagata et al, 2009		○						○	
	脳虚血で誘発した認知障害	Ge et al, 2012		○							○
	敗血症で誘発した認知障害	Zhou et al, 2012a; Liu et al, 2015		○					○		○
	肝切除で誘発した認知障害	Tian et al, 2016		○					○		
	外傷性脳傷害で誘発した認知欠損	Hou et al, 2012		○					○		
	アルツハイマー病	Li et al, 2010; Wang et al, 2011a		○					○		
	老化促進マウスにおける老年性認知障害	Gu et al, 2010		○						○	
	パーキンソン病	Fu et al, 2009; Fujita et al, 2009; Ito et al, 2012; Yoritaka et al, 2013; Matsumoto et al, 2013		○		○				○	○
	出血性梗塞	Chen et al, 2010b		○							○
	脳内出血	Manaenko et al, 2011; Manaenko et al, 2013		○							○

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			細胞	齧歯類	その他動物	ヒト	培養液	生食	水	ガス	その他
脳	脳外傷	Ji et al, 2010		○							○
	外傷性脳傷害	Ji et al, 2012; Yuan et al, 2015		○				○		○	
	CO中毒	Sun et al, 2011b; Wang et al, 2012a; Wang et al, 2012c; Shen et al, 2013		○				○			
	一過性で広範な脳虚血	Hugyecz et al, 2011		○							○
	頸動脈の結紮による脳虚血	Nagatani et al, 2012		○							○
	くも膜下出血における脳傷害	Zhan et al, 2012; Zhuang et al, 2012; Zhuang et al, 2013; Hong et al, 2014; Shao et al, 2015		○		○			○		○
	くも膜下出血における脳血管攣縮	Hong et al, 2012		○					○		
	海馬の循環停止で誘発した脳傷害	Shen et al, 2011		○					○		
	外科的に誘発した脳傷害	Eckermann et al, 2011		○							○
	脳血管結紮で誘発した脳虚血	Li et al, 2012c		○					○		
	LPSで誘発した神経炎症と疾病行動	Spulber et al, 2012		○	○				○		○
	両側総頸動脈結紮による脳傷害	Nagatani et al, 2013		○							○
心停止蘇生後の脳傷害	Huo et al, 2014		○					○			

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脳	外傷性脳障害で誘発した神経変性	Dohi et al, 2014		○						○	
	クロルピリホスで誘発した神経毒性	Wang et al, 2014		○						○	
	脳卒中における神経学的症状	Takeuchi et al, 2015		○						○	
	脳虚血傷害	Han et al, 2015		○						○	
	低酸素/再酸素化誘発細胞死	Wei et al, 2015		○				○			
	ALS	Zhang et al, 2015		○						○	
	自己免疫性脳脊髄炎	Zhao et al, 2016		○						○	
	うつ様行動	Zhang et al, 2016		○						○	
	外傷性脳傷害後の脳障害と炎症	Tian et al, 2016		○						○	
	脳虚血再灌流障害	Cui et al, 2016; Li et al, 2016		○						○	○
神経/脊髄	脊髄傷害	Chen et al, 2010a; Wang et al, 2015		○						○	
	脊髄の虚血再灌流傷害	Huang et al, 2011b; Zhou et al, 2013			○					○	○
	神経因性疼痛	Chen et al, 2013; Kawaguchi et al, 2014; Ge et al, 2014; Chen et al, 2015		○						○	○
	アストログリア増殖症	Liu et al, 2014		○	○				○	○	
	レミフェンタニル誘発痛覚過敏	Zhang et al, 2014a; Shu et al, 2015		○						○	
	レミフェンタニル誘発高侵害受容作用	Zhang et al, 2014b		○						○	

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神経/脊髄	神経細胞死	Kashiwagi et al, 2014	○				○				
	末梢神経の自己移植	Zhang et al, 2016		○				○			
眼	緑内障	Oharazawa et al, 2010		○							○
	アルカリで誘発した角膜腐食	Kubota et al, 2011		○							○
	網膜傷害	Wei et al, 2012; Tian et al, 2013; Feng et al, 2012; Qi et al, 2015; Zhang et al, 2016		○				○			
	網膜ミクログリア細胞の LPS 誘発炎症	Liu et al, 2013	○					○			
	亜セレン酸誘発白内障	Yang et al, 2013		○				○			
	視神経クラッシュ	Sun et al, 2014		○				○			
	網膜の虚血再灌流障害	Liu et al, 2015; Wang et al, 2016		○				○		○	
	網膜の酸化ストレス	Yokota et al, 2015	○					○			
	光受容体変性	Chen et al, 2016		○				○			
	白内障手術時の角膜内皮障害	Igarashi et al, 2016				○		○			
耳	聴覚障害	Kikkawa et al, 2009; Taura et al, 2010; Lin et al, 2011	○	○				○		○	
	ウアバイン誘発聴器神経傷害	Qu et al, 2012a		○							○
	騒音で誘発した聴覚消失	Zhou et al, 2012b; Kurioka et al, 2014; Chen et al, 2014		○				○		○	

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耳	シスプラチン誘発聴器毒性	Qu et al, 2012b; Kikkawa et al, 2014;	○	○			○				○	
肺	酸素誘発肺傷害	Sun et al, 2011c; Huang et al, 2010; Zheng et al, 2010; Huang et al, 2011a; Kawamura et al, 2013		○				○			○	
	パラコート誘発肺傷害	Liu et al, 2011a		○				○				
	放射線誘発肺傷害	Terasaki et al, 2011; Chuai et al, 2011		○					○			
	火傷誘発肺傷害	Qiu et al, 2010; Fang et al, 2011		○				○				
	腸の虚血再灌流傷害で誘発した肺傷害	Mao et al, 2009		○				○				
	LPS 誘発急性肺傷害	Qiu et al, 2011; Xie et al, 2012a; Liang et al, 2012; Liu et al, 2015; Zhang et al, 2015		○				○			○	
	肺の虚血再灌流傷害	Li et al, 2012b; Shi et al, 2012		○	○			○				
	敗血症ショック誘発性の肺と腸の傷害	Liu et al, 2013		○							○	
	出血性ショック誘発性の肺傷害	Shi et al, 2013; Du et al, 2014a		○				○			○	
	心肺バイパスにおける炎症反応	Fujii et al, 2013		○							○	
	慢性閉塞性肺疾患 (COPD)	Ning et al, 2013		○				○				
心臓死の後の肺灌流	Haam et al, 2015			○						○		

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肺	肺移植におけるドナーの遺伝子変化	Tanaka et al, 2012		○							○
	敗血症由来の肺障害	Zhai et al, 2015; Tao et al, 2016		○						○	
	タバコ誘発肺障害	Chen et al, 2015		○						○	
	出血性ショック誘発肺障害	Kohama et al, 2015		○							○
	肺移植	Noda et al, 2014; Liu et al, 2015		○							○
	海水注入で誘発した肺障害	Diao et al, 2016				○					○
気管	OVA で誘発した喘息	Xiao et al, 2013		○						○	
心臓	急性心筋梗塞	Zhang et al, 2011; Sun et al, 2009; Hayashida et al, 2008; Yoshida et al, 2012; Sakai et al, 2012; Jing et al, 2014		○	○					○	○
	心移植	Nakao et al, 2010a; Noda et al, 2012; Noda et al, 2013		○						○	○ ○
	左心室肥大	Yu et al, 2012		○						○	
	放射線誘発心筋傷害	Qian et al, 2010a		○						○	
	睡眠時無呼吸で誘発された心臓の低酸素症	Hayashi et al, 2011		○							○
	心肺停止蘇生後の脳・心臓障害	Hayashida et al, 2012		○							○

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心臓	心肺停止蘇生後の脳障害	Huang et al, 2013; Hayashida et al, 2014		○	○			○		○	
	虚血再灌流傷害とニトロチロシン産生	Shinbo et al, 2013		○						○	
	心臓の虚血再灌流障害	Tan et al, 2013; Zhao et al, 2014; Zhang et al, 2015; Pan et al, 2015		○				○			○
	低酸素による左心室リモデリング	Kato et al, 2014		○						○	
	糖尿病性心筋症	Wu et al, 2015		○					○		
	心筋細胞の虚血による障害	Xie et al, 2014		○				○			
	ドキシソルビシン誘発心不全	Wu et al, 2014		○				○			
	LPS 誘発心不全	Tao et al, 2015		○				○			
	心停止後の心機能と神経学的転帰	Wang et al, 2016		○						○	
心停止後症候群	Tamura et al, 2016								○	○	
肝臓	住血吸虫に起因した慢性肝炎	Gharib et al, 2001		○						○	
	肝の虚血再灌流傷害	Fukuda et al, 2007; Liu et al, 2014; Zhang et al, 2015; Matsuno et al, 2014		○	○			○		○	
	肝炎	Kajiya et al, 2009a		○							○
	非アルコール性肝炎	Kawai et al, 2012		○					○		
	閉塞性黄疸	Liu et al, 2010; Liu et al, 2016		○				○			

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肝臓	四塩化炭素誘発肝障害	Sun et al, 2011a		○				○			
	肝腫瘍治療における放射線障害	Kang et al, 2011				○		○			
	肝臓の遺伝子発現	Nakai et al, 2011		○				○			
	肝切除による肝傷害	Xiang et al, 2012			○					○	
	肝切除による肝不全	Tan et al, 2014		○				○			
	肝の線維化	Koyama Y et al, 2013		○				○			
	B型肝炎	Xia et al, 2013				○		○			
	エンドトキシン誘発肝障害	Xu and Zhang, 2013		○				○			
	肝硬変の血行動態	Lee et al, 2014		○				○			
	アセトアミノフェン誘発肝毒性	Zhang et al, 2015		○				○			
	肝再生	Yu et al, 2015		○							○
	熱傷における肝機能	Liu et al, 2014		○				○			
低酸素/再酸素化障害	Yu et al, 2015		○	○			○	○			
腎臓	血液透析	Nakayama et al, 2007; Nakayama et al, 2009; Nakayama et al, 2010; Terawaki et al, 2014; Terawaki et al, 2015; Tange et al, 2015				○					○
	腹膜透析	Terawaki et al, 2013				○					○



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腎臓	シスプラチン誘発腎症	Nakashima-Kamimura et al, 2009; Kitamura et al, 2010; Matsushita et al, 2011b		○					○	○	
	ゲンタマイシン誘発腎毒性	Matsushita et al, 2011a		○					○		
	腎移植	Cardinal et al, 2010		○					○		
	腎の虚血再灌流傷害	Wang et al, 2011b; Shingu et al, 2010; Abe et al, 2012; Zeng et al, 2014; Li et al, 2016a; Li et al, 2016b		○			○	○			○
	メラミン誘発尿石	Yoon et al, 2011b		○					○		
	糖尿病腎症	Katakura et al, 2012		○					○		
	慢性腎臓病	Zhu et al, 2011		○					○		
	片側尿管結紮による腎障害	Xu et al, 2013		○					○		
	鉄ニトリロ三酢酸誘発腎毒性	Li et al, 2013		○					○		
	Dahl 食塩感受性ラットにおける心-腎障害	Zhu et al, 2013		○					○		
	横紋筋融解症における腎障害	Gu et al, 2014		○					○		
	自然発症高血圧ラット (SHR) における腎障害	Xin et al, 2014		○					○		
敗血症ショック時の腎障害	Liu et al, 2014		○							○	

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腎臓	造影剤誘発腎障害	Homma et al, 2015		○							○
	腎石症	Peng et al, 2015		○							○
	重症火傷における急性腎障害	Guo et al, 2015		○				○			
	肝移植後の急性腎障害	Du et al, 2016		○				○			
膵臓	急性膵炎	Chen et al, 2010c; Zhang et al, 2012; Zhang et al, 2013; Ren et al, 2014; Zhou et al, 2016; Han et al, 2016	○	○				○	○		○
	外傷誘発膵炎	Ren et al, 2012		○				○			
	タウロコール酸誘発膵炎	Shi et al, 2015		○				○			
	膵臓移植後の虚血再灌流障害	Lou et al, 2015		○				○			
	急性壊死性膵炎	Shi et al, 2016		○				○			
精巣	精巣の虚血再灌流傷害	Jiang et al, 2012a; Lee et al, 2012		○				○			○
	精巣の放射線傷害	Jiang et al, 2012b		○				○			
	生殖細胞の放射線傷害	Chuai et al, 2012a		○				○			
	放射線誘発精子形成障害と造血機能障害	Chuai et al, 2012b		○				○			
	ニコチン誘発性精巣傷害	Li et al, 2013		○				○			
	精子の生存率	Nakata et al, 2015	○					○			
	煙草煙誘発精巣障害	Chen et al, 2015		○				○			
卵巣	シスプラチン誘発卵巣障害	Meng et al, 2015		○				○			

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卵巣	早発卵巣不全	He et al, 2016		○				○			
	卵巣の虚血再灌流障害	Gokalp et al, 2016		○				○			
子宮	子宮内膜症	He et al, 2016		○						○	
胃	ストレス誘発胃潰瘍	Liu et al, 2012		○				○			
	アスピリン誘発胃障害	Xue et al, 2014; Zhang et al, 2014		○					○		
腸	腸移植	Buchholz et al, 2008; Zheng et al, 2009; Buchholz et al, 2011		○				○	○		○
	潰瘍性大腸炎	Kajiya et al, 2009b; He et al, 2013		○				○			○
	腸の虚血再灌流傷害	Chen et al, 2011; Shigeta et al, 2015		○				○			
	出血性ショックにおける腸管障害	Du et al, 2015		○				○			
	腸閉塞	Okamoto et al, 2016		○				○			
血管	動脈硬化	Ohsawa et al, 2008		○						○	
	アテローム性動脈硬化	Song et al, 2012		○				○			
	バルーンで誘発した血管の内 膜傷害と内膜肥厚	Qin et al, 2012; Chen et al, 2013	○	○				○	○		
	移植血管における内膜肥厚	Sun et al, 2012a		○						○	
	血管傷害	Zheng et al, 2012		○				○			
	糖化最終産物誘発性の血管内皮 傷害	Jiang et al, 2013	○					○			

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血管	塩化カルシウムで誘発した動脈瘤	Chen et al, 2013; Song et al, 2013; Chen et al, 2014		○					○		
	血管内皮機能	Sakai et al, 2014								○	
	血管内皮への単球接着と血管透過性	Xie et al, 2015; Yu et al, 2015	○						○		
	動脈硬化におけるプラーク	Song et al, 2015a		○						○	
	血管平滑筋の肥大・増殖	Zhang et al, 2016	○	○					○		○
筋肉	炎症性及びミトコンドリア性筋炎	Ito et al, 2011								○	
	筋肉疲労	Aoki et al, 2012								○	
	腓腹筋萎縮	Fujita et al, 2011		○						○	
	骨格筋の虚血再灌流障害	Huang et al, 2015		○					○		
	軟部組織障害	Ostojic et al, 2014								○	○
	運動負荷による酸化ストレス	Yamazaki et al, 2015							○		
	筋ジストロフィー	Hasegawa et al, 2016		○						○	
軟骨・骨	NO 誘発性軟骨障害	Hanaoka et al, 2011	○						○		
	微小重力による骨欠損	Sun et al, 2012b		○						○	
	骨減少症	Guo et al, 2012		○						○	
	TNF $\alpha$ 誘発骨芽細胞傷害	Cai et al 2013	○						○		
	骨・軟骨組織の生存率	Yamada et al, 2014	○						○		

対象器官 又は疾患	疾患又は疾患モデル	著者及び報告年	使用動物種				投与形態					
			細胞	齧歯類	その他動物	ヒト	培養液	生食	水	ガス	その他	
軟骨・骨	破骨細胞の分化	Li et al, 2014	○				○					
	ステロイド誘発大腿骨壊死	Huang et al, 2016			○			○				
関節	関節リウマチ	Ishibashi et al, 2012; Ishibashi et al, 2014; Meng et al, 2016		○		○		○	○			
	乾癬性関節炎	Ishibashi et al, 2015				○		○	○	○		
歯	歯周病	Kasuyama et al, 2011; Azuma et al, 2015		○		○				○		
	歯周病における大動脈の脂質沈着	Ekuni et al, 2012		○						○		
	歯周組織の老化	Tomofuji et al, 2014		○						○		
	線維芽細胞の酸化ストレス	Xiao et al, 2016	○							○		
皮膚	紫外線を照射した線維芽細胞傷害とケラチノサイトのしわ形成	Kato et al, 2012a	○			○		○				○
	紫外線誘発皮膚傷害	Yoon et al, 2011a; Guo et al, 2012		○						○		○
	急性紅斑性皮膚疾患	Ono et al, 2012				○				○		
	皮膚移植における虚血再灌流傷害	Zhao et al, 2013		○						○		
	紫外線誘発皮膚傷害	Ignacio et al, 2013a		○								○
	褥瘡	Li et al, 2013	○			○		○		○		
	アトピー性皮膚炎	Ignacio et al, 2013b; Yoon et al, 2014		○						○		

対象器官 又は疾患	疾患又は疾患モデル	著者及び報告年	使用動物種				投与形態				
			細胞	齧歯類	その他動物	ヒト	培養液	生食	水	ガス	その他
皮膚	放射線誘発皮膚炎と皮膚障害	Watanabe et al, 2014		○							○
	熱傷の進行	Guo et al, 2015		○					○		
	火傷による炎症	Wang et al, 2015		○					○		
	皮膚の虚血再灌流障害	Liu et al, 2015		○					○		
	局所の放射線照射による皮膚炎	Mei et al, 2014		○					○		
代謝	I型糖尿病	Li et al, 2011; Amitani et al, 2013		○		○		○		○	
	II型糖尿病	Kajiyama et al, 2008; Wang et al, 2012		○		○		○	○		
	メタボリックシンドローム	Nakao et al, 2010b; Hashimoto et al, 2011; Song et al, 2013		○		○				○	
	高コレステロール血症	Zong et al, 2012; Song et al, 2015b		○		○			○		
	糖尿病及び肥満	Kamimura et al, 2011		○						○	
	糖尿病性勃起不全	Fan et al, 2012		○					○		
	糖尿病性網膜症	Feng et al, 2012; Xiao et al, 2012		○					○		
	肝細胞の脂肪酸取り込みと脂質蓄積	Iio et al, 2013		○					○		
	脂質代謝	Kamimura et al, 2016		○						○	
周産期異常	新生児低酸素脳症	Cai et al, 2008; Domoki et al, 2010; Cai et al, 2009		○	○				○		○
	子癇（妊娠高血圧腎症）	Yang et al, 2011; Ushida et al, 2016		○					○	○	

対象器官 又は疾患	疾患又は疾患モデル	著者及び報告年	使用動物種				投与形態				
			細胞	齧歯類	その他動物	ヒト	培養液	生食	水	ガス	その他
周産期異常	母体低酸素による脳傷害	Liu et al, 2011		○							○
	新生児の高酸素誘発網膜症	Huang et al, 2012		○				○			
	新生児における麻酔薬吸入で誘発された認知障害	Yonamine et al, 2013		○							○
	新生児の壊死性腸炎	Sheng et al, 2013		○				○			
	胎児の海馬障害	Mano et al, 2014		○							○
	新生児の脳室内胚芽層出血	Lekic et al, 2011		○							○
	LPS 誘発新生児肺傷害	Hattori et al, 2015		○							○
	新生児の神経血管障害	Oláh et al, 2015				○					○
	新生児における麻酔薬吸入で誘発された母性行動の欠如	Takaenoki et al, 2014		○							○
	新生児の気管支肺異形成症	Muramatsu et al, 2016		○							○
	LPS 誘発新生児脳障害	Imai et al, 2016		○							○
	新生児の虚血性脳障害	Bai et al, 2016		○							○
炎症・アレルギー	I 型アレルギー	Itoh et al, 2009		○							○
	敗血症	Xie et al, 2010a; Li et al, 2012a; Xie et al, 2012; Liu et al, 2014a; Liu et al, 2014b; Li et al, 2014; Li et al, 2015a; Li et al, 2015b		○						○	○
	ザイモザン誘発炎症	Xie et al, 2010b; Hong et al, 2016		○							○

対象器官 又は疾患	疾患又は疾患モデル	著者及び報告年	使用動物種				投与形態				
			細胞	齧歯類	その他動物	ヒト	培養液	生食	水	ガス	その他
炎症・アレルギー	LPS/IFN- $\gamma$ 誘発 NO 産生	Itoh et al, 2011	○	○			○		○		
	カラゲニン足浮腫およびマクロファージの TNF $\alpha$ 産生	Xu et al, 2012	○	○			○	○			
	LPS 誘発マクロファージ炎症	Chen et al, 2013	○				○				
癌	舌癌細胞増殖	Saitoh et al, 2008; Saitoh et al, 2009	○				○				
	肺癌細胞で誘発した血管新生	Ye et al, 2008	○				○				
	放射線誘発胸腺リンパ腫	Zhao et al, 2011		○				○			
	癌細胞殺傷作用	Kagawa et al, 2012	○								○
	抗腫瘍作用	Dole et al, 1975		○							○
	抗癌剤の抗腫瘍作用増強	Runtuwene et al, 2015		○					○		
高血圧	モノクロタリン誘発肺高血圧	Wang et al, 2011c; He et al, 2013; Kishimoto et al, 2015		○				○	○		
その他	潜水病	Ni et al, 2011		○				○			
	多能性幹細胞の生存	Kawasaki et al, 2010	○								○
	放射線誘発細胞傷害	Qian et al, 2010b; Qian et al, 2010c	○				○				
	酸化 LDL 誘発細胞毒性	Song et al, 2011	○				○				
	高グルコース誘発酸化ストレス	Yu et al, 2011	○				○				
	AAPH 誘発酸化ストレス	Yanagihara et al, 2005		○					○		
	寿命	Yan et al, 2010			○		○				
	運動負荷による酸化ストレス	Koyama et al, 2008; Tsubone et al, 2013			○	○			○		



対象器官 又は疾患	疾患又は疾患モデル	著者及び報告年	使用動物種				投与形態							
			細胞	齧歯類	その他動物	ヒト	培養液	生食	水	ガス	その他			
その他	運動負荷による代謝性アシドーシス	Ostojic et al, 2014				○						○		
	血小板凝集	Takeuchi et al, 2012		○		○	○	○				○		
	放射線誘発アポトーシス	Yang et al, 2012	○				○							
	ラジカル産生および血液流動性	Kato et al, 2012	○									○		
	骨髄移植における GVHD (移植片対宿主病)	Qian et al, 2013		○								○		
	慢性 GVHD	Qian and Shen, 2016				○						○		
	再生不良性貧血	Zhao et al, 2013		○								○		
	放射線誘発免疫機能障害	Zhao et al, 2014		○								○		
	急性腹膜炎	Zhang et al, 2014		○								○		
	出血性ショック	Du et al, 2014		○								○		
	血液幹細胞移植	Yuan et al, 2015		○								○		
	情報伝達	Sobue et al, 2015		○								○	○	
	組織内濃度	Liu et al, 2014		○								○	○	○
	ヒトリンパ球細胞に対する 12C6 + 重イオン照射	Yang et al, 2013		○								○		
	膀胱下尿道閉塞	Miyazaki et al, 2015		○								○		
口蓋内創傷	Tamaki et al, 2016		○								○			

対象器官 又は疾患	疾患又は疾患モデル	著者及び報告年	使用動物種				投与形態					
			細胞	齧歯類	その他動物	ヒト	培養液	生食	水	ガス	その他	
その他	細胞死と老化	Han et al, 2016	○				○					
	細胞老化	Hara et al, 2016	○				○					

2016年11月末までの掲載論文をMiZ株式会社で調査し本資料を作成した。

掲載文献 (アルファベット順)

Abe T, Li XK, Yazawa K, *et al* (2012): Hydrogen-rich University of Wisconsin solution attenuates renal cold ischemia-reperfusion injury. *Transplantation*, **94**: 14-21.

Amitani H, Asakawa A, Cheng K, *et al* (2013): Hydrogen improves glycemic control in type 1 diabetic animal model by promoting glucose uptake into skeletal muscle. *PLoS One*, **8**: e53913.

Aoki K, Nakao A, Adachi T, *et al* (2012): Pilot study: Effects of drinking hydrogen-rich water on muscle fatigue caused by acute exercise in elite athletes. *Med Gas Res*, **2**: 12.

Azuma T, Yamane M, Ekuni D, *et al* (2015): Drinking hydrogen-rich water has additive effects on non-surgical periodontal treatment of improving periodontitis: A pilot study. *Antioxidants*, **4**: 513-522.

Bai X, Liu S, Yuan L, *et al* (2016): Hydrogen-rich saline mediates neuroprotection through the regulation of endoplasmic reticulum stress and autophagy under hypoxia-ischemia neonatal brain injury in mice. *Brain Res*, **1646**: 410-417.

Buchholz BM, Kaczorowski DJ, Sugimoto R, *et al* (2008): Hydrogen inhalation ameliorates oxidative stress in transplantation induced intestinal graft injury. *Am J Transplant*, **8**: 1-10.

Buchholz BM, Masutani K, Kawamura T, *et al* (2011): Hydrogen-enriched preservation protects the isogeneic intestinal graft and amends recipient gastric function during transplantation. *Transplant*, **92**: 985-992.

Cai J, Kang Z, Liu WW, *et al* (2008): Hydrogen therapy reduced apoptosis in neonatal hypoxia-ischemia rat model. *Neurosci Lett*, **441**: 167-172.

Cai J, Kang Z, Liu K, *et al* (2009): Neuroprotective effects of hydrogen saline in neonatal hypoxia-ischemia rat model. *Brain Res*, **1256**: 129-137.

Cai WW, Zhang MH, Yu YS, *et al* (2013): Treatment with hydrogen molecule alleviates TNF $\alpha$ -induced cell injury in osteoblast. *Mol Cell Biochem*, **373**: 1-9.

Cardinal JS, Zhan J, Wang Y, *et al* (2010): Oral hydrogen water prevents chronic allograft nephropathy in rats. *Kidney Int*, **77**: 101-109.

Chen C, Chen Q, Mao Y, *et al* (2010a): Hydrogen-rich saline protects against spinal cord injury in rats. *Neurochem Res*. **35**: 1111-1118.

Chen CH, Manaenko A, Zhan Y, *et al* (2010b): Hydrogen gas reduced acute hyperglycemia-enhanced hemorrhagic transformation in a focal ischemia rat model. *Neuroscience*. **169**: 402-414.

Chen F, Xiong J, Guo W, *et al* (2013): Suppression of experimental abdominal aortic aneurysm by saturated hydrogen saline: a preliminary study with rats. *Zhonghua Wai Ke Za Zhi*, **51**: 437-441. (in Chinese).

Chen F, Zhang T, Xiong J, *et al* (2014): Suppression of abdominal aortic aneurysm by hydrogen through chemokine-like factor1. *Zhonghua Yi Xue Za Zhi*, **94**: 59-61. (in Chinese).

Chen H, Sun YP, Li Y, *et al* (2010c): Hydrogen-rich saline ameliorates the severity of l-arginine-induced acute pancreatitis in rats. *Biochem Biophys Res Commun.* **393**: 308-313.

Chen H, Sun YP, Hu PF, *et al* (2011): The effects of hydrogen-rich saline on the contractile and structural changes of intestine induced by ischemia-reperfusion in rats. *J Surg Res*, **167**: 316-322.

Chen HG, Xie KL, Han HZ, *et al* (2013): Heme oxygenase-1 mediates the anti-inflammatory effect of molecular hydrogen in LPS-stimulated RAW 264.7 macrophages. *Int J Surg.* **11**:1060-1066.

Chen L, Yu N, Lu Y, *et al* (2014): Hydrogen-saturated saline protects intensive narrow band noise-induced hearing loss in guinea pigs through an antioxidant effect. *PLoS One.* **9** (6):e100774.

Chen Q, Chen P, Zhou S, *et al* (2013): Hydrogen-rich saline attenuated neuropathic pain by reducing oxidative stress. *Can J Neurol Sci* **40**: 857-863.

Chen S, Jiang W (2015): Effect of hydrogen injected subcutaneously on testicular tissues of rats exposed to cigarette smoke. *Int J Clin Exp Med.* **8**: 5565-5570.

Chen T, Tao Y, Yan W, *et al* (2016): Protective effects of hydrogen-rich saline against N-methyl-N-nitrosourea-induced photoreceptor degeneration. *Exp Eye Res*, **148**: 65-73.

Chen X, Liu Q, Wang D, et al (2015): Protective effects of hydrogen-rich saline on rats with smoke inhalation injury. *Oxid Med Cell Longev.* 2015:106836. doi: 10.1155/2015/106836. Epub 2015 May 21.

Chen Y, Jiang J, Miao H, et al (2013): Hydrogen-rich saline attenuates vascular smooth muscle cell proliferation and neointimal hyperplasia by inhibiting reactive oxygen species production and inactivating the Ras-ERK1/2-MEK1/2 and Akt pathways. *Int J Mol Med*, **31**: 597-606.

Chen Y, Chen H, Xie K, et al (2015): H<sub>2</sub> Treatment attenuated pain behavior and cytokine release through the HO-1/CO pathway in a rat model of neuropathic pain. *Inflammation*. **38**:1835-1846.

Chuai Y, Zhao L, Ni J, et al (2011): A possible prevention strategy of radiation pneumonitis: combine radiotherapy with aerosol inhalation of hydrogen-rich solution. *Med Sci Monit*, **17**: 1-4.

Chuai Y, Gao F, Li B, et al (2012a): Hydrogen-rich saline attenuates radiation-induced male germ cell loss in mice through reducing hydroxyl radicals. *Biochem J*, **442**: 49-56.

Cauai Y, Shen J, Qian L, et al (2012b): Hydrogen-rich saline protects spermatogenesis and hematopoiesis in irradiated BALB/c mice. *Med Sci Monit*, **18**: BR89-94.

Cui J, Chen X, Zhai X, et al (2016): Inhalation of water electrolysis-derived hydrogen ameliorates cerebral ischemia-perfusion injury in rats – A possible new hydrogen resource for clinical use. *Neuroscience*, **335**: 232-241.

Cui Y, Zhang H, Ji M, et al (2014): Hydrogen-rich saline attenuates neuronal ischemia-reperfusion injury by protecting mitochondrial

function in rats. *J Surg Res*, 2014 May 24. pii: S0022-4804(14)00529-0. doi: 10. 1016/j. jss. 2014. 05. 060. [Epub ahead of print].

Diao M, Zhang S, Wu L, *et al* (2016): Hydrogen gas inhalation attenuates seawater instillation-induced acute lung injury via the Nrf2 pathway in rabbits. *Inflammation* 2016 Sep 5 [Epub ahead of print].

Dohi K, Kraemer BC, Erikson MA, *et al* (2014): Molecular hydrogen in drinking water protects against neurodegenerative changes induced by traumatic brain injury. *PLoS ONE*, **9**: e108034.

Dole M, Wilson FR, and Fife WP (1975): Hyperbaric hydrogen therapy: A possible treatment for cancer. *Science*, **190**: 152-154.

Domoki F, Oláh O, Zimmermann A, *et al* (2010): Hydrogen is neuroprotective and preserves cerebrovascular reactivity in asphyxiated newborn pigs. *Pediatr Res*. **68**: 387-392.

Du H, Sheng M, Wu L, *et al* (2016): Hydrogen-rich saline attenuates acute kidney injury after liver transplantation via activating p53-mediated autophagy. *Transplantation*, **100**: 563-570.

Du Z, Jia H, Liu J, *et al* (2014a): Effects of three hydrogen-rich liquids on hemorrhagic shock in rats. *J Surg Res*, 2014 Jul 3. pii: S0022-4804(14)00629-5. doi: 10. 1016/j. jss. 2014. 06. 051. [Epub ahead of print].

Du Z, Jia H, Liu J, *et al* (2014b): Protective effects of hydrogen-rich saline in uncontrolled hemorrhage shock. *Exp Therap Med*, **7**: 1253-1258.

Du Z, Liu J, Jia H, *et al* (2015): Three hydrogen-rich solutions protect against intestinal injury in uncontrolled hemorrhagic shock. *Int*

J Clin Exp Med, 8: 7620-7626.

Eckermann JM, Chen W, Jadhav V, *et al* (2011): Hydrogen is neuroprotective against surgically induced brain injury. Med gas Res, 1:7.

Ekuni D, Tomofuji T, Endo Y, *et al* (2012): Hydrogen-rich water prevents lipid deposition in the descending aorta in a rat periodontitis model. Arch Oral Biol. May 16. [Epub ahead of print].

Fan M, Xu X, He X, *et al* (2012): Protective effects of hydrogen-rich saline against erectile dysfunction in a streptozotocin-induced diabetic rat model. J Urol, Dec 4. pii: S0022-5347(12)05812-0. doi: 10.1016/j.juro.2012.12.001. [Epub ahead of print].

Fang Y, Fu XJ, Gu C, *et al* (2011): Hydrogen-rich saline protects against acute lung injury induced by extensive burn in rat model. J Burn Care Res. 32: e82-91.

Feng M, Wang XH, Yang XB, *et al* (2012): Protective effect of saturated hydrogen saline against blue light-induced retinal damage in rats. Int J Ophthalmol, 5: 151-157.

Feng Y, Wang R, Xu J, *et al* (2012): Hydrogen-rich saline prevents early neurovascular dysfunction resulting from inhibition of oxidative stress in STZ-diabetic rats. Curr Eye Res, 2012 Dec 19. [Epub ahead of print].

Fu Y, Ito M, Fujita Y, *et al* (2009): Molecular hydrogen is protective against 6-hydroxydopamine-induced nigrostriatal degeneration in a rat model of Parkinson's disease. Neurosci Lett, 453: 81-85.



- Fujii Y, Shirai M, Inamori S, *et al* (2013): Insufflation of hydrogen gas restrains the inflammatory response of cardiopulmonary bypass in a rat model. *Artif Organs*, **37**: 136-141.
- Fujita K, Seike T, Yutsudo N, *et al* (2009): Hydrogen in drinking water reduces dopaminergic neuronal loss in the 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine mouse model of Parkinson's disease. *PLoS One*, **4**: e7247.
- Fujita R, Tanaka Y, Saihara Y, *et al* (2011): Effect of molecular hydrogen saturated alkaline electrolyzed water on disuse muscle atrophy in gastrocnemius muscle. *J Physiol Anthropol*, **30**: 195-201.
- Fukuda K, Asoh S, Ishikawa M, *et al* (2007): Inhalation of hydrogen gas suppresses hepatic injury caused by ischemia/reperfusion through reducing oxidative stress. *Biochem Biophys Res Commun*, **361**: 670-674.
- Gharib B, Hanna S, Abdallahi OMS, *et al* (2001): Anti-inflammatory properties of molecular hydrogen: investigation on parasite-induced liver inflammation. *C R Acad Sci III*, **324**: 719-724.
- Ge P, Zhao J, Li S, *et al* (2012): Inhalation of hydrogen gas attenuates cognitive impairment in transient cerebral ischemia via inhibition of oxidative stress. *Neurol Res*. **34**: 187-194.
- Ge Y, Wu F, Sun X, *et al* (2014): Intrathecal infusion of hydrogen-rich normal saline attenuates neuropathic pain via inhibition of activation of spinal astrocytes and microglia in rats. *PLoS ONE*, **9**: e109482.
- Gokalp N, Basaklar AC, Sonmez K, *et al* (2016): Protective effect of hydrogen rich saline solution on experimental ovarian ischemia reperfusion model in rats. *J Pediatr Surg*, 2016 Oct 21. pii: S0022-3468(16)30467-5. doi: 10.1016/j.jpedsurg.2016.10.006. [Epub ahead

of print].

Gu H, Yang M, Zhao X, *et al* (2014): Pretreatment with hydrogen-rich saline reduces the damage caused by glycerol-induced rhabdomyolysis and acute kidney injury in rats. *J Surg Res*, **188**: 243-249.

Gu Y, Huang CS, Inoue T, *et al* (2010): Drinking hydrogen water ameliorated cognitive impairment in senescence-accelerated mice. *J Clin Biochem Nutri*, **46**: 269-276.

Guo JD, Li L, Shi YM, *et al* (2012): Hydrogen water consumption prevents osteopenia in ovariectomized rats. *Br J Pharmacol*, 2012 Nov 2. doi: 10. 1111/bph. 12036. [Epub ahead of print].

Guo SX, Jin YY, Fang Q, *et al* (2015): Beneficial effects of hydrogen-rich saline on early burn-wound progression in rats. *PLoS One*. **10** (4):e0124897.

Guo SX, Fang Q, You CG, *et al* (2015): Effects of hydrogen-rich saline on early acute kidney injury in severely burned rats by suppressing oxidative stress induced apoptosis and inflammation. *J Transl Med*, **13**: 183.

Guo Z, Zhou B, Li W, *et al* (2012): Hydrogen-rich saline protects against ultraviolet B radiation injury in rats. *J Biomed Res*, **26**: 365-371.

Haam S, Lee S, Paik HC, *et al* (2015): The effects of hydrogen gas inhalation during ex vivo lung perfusion on donor lungs obtained after cardiac death. *Eur J Cardiothorac Surg*. 2015 Mar 6. pii: ezv057. [Epub ahead of print]

Han AL, Park SH, Park MS (2016): Hydrogen treatment protects against cell death and senescence induced by oxidative damage. *J Microbiol Biotechnol*, 2016 Oct 25. doi: 10.4014/jmb.1608.08011. [Epub ahead of print] .

Han B, Zhou H, Jia G, et al (2016): MAPKs and Hsc 70 are critical to the protective effect of molecular hydrogen during the early phase of acute pancreatitis. *FEBS J*, **283**: 738-756.

Han L, Tian R, Yan H, *et al* (2015): Hydrogen-rich water protects against ischemic brain injury in rats by regulating calcium buffering proteins. *Brain Res*. 2015 Apr 25. pii: S0006-8993(15)00334-0. doi: 10.1016/j.brainres.2015.04.038. [Epub ahead of print]

Hanaoka T, Kamimura N, Yokota T, *et al* (2011): Molecular hydrogen protects chondrocytes from oxidative stress and indirectly alters gene expression through reducing peroxynitrite derived from nitric oxide. *Med Gas Res*, **1**:18.

Hara F, Tatebe J, Watanabe I, *et al* (2016): Molecular hydrogen alleviates cellular senescence in endothelial cells. *Cric J*, **80**: 2037-2046.

Hasegawa S, Ito M, Fukami M, *et al* (2016): Molecular hydrogen alleviates motor deficits and muscle degeneration in mdx mice. *Redox Rep*, **15**: 1-9.

Hashimoto M, Katakura M, Nabika T, *et al* (2011): Effects of hydrogen-rich water on abnormalities in a SHR.Cg-Lepr<sup>CP</sup>/NDmcr rat – a metabolic syndrome rat model. *Med Gas Res*, **1**: 26.

Hattori Y, Kotani T, Tsuda H, *et al* (2015): Maternal molecular hydrogen attenuates lipopolysaccharide-induced rat fetal lung injury. *Free Radic Res*, 2015 May 7: 1-12. [Epub ahead of print]

Hayashida K, Sano M, Ohsawa I, *et al* (2008): Inhalation of hydrogen gas reduces infarct size in the rat model of myocardial ischemia-reperfusion injury. *Biochem Biophys Res Commun*, **373**: 30-35.

Hayashida K, Sano M, Kamimura N, *et al* (2012): H<sub>2</sub> gas improves functional outcome after cardiac arrest to an extent comparable to therapeutic hypothermia in a rat model. *J Am Heart Assoc*. 2012; 1: e003459 doi: 10.1161/JAHA.112.003459.

Hayashida K, Sano M, Kamimura N, *et al* (2014): Hydrogen inhalation during normoxic resuscitation improves neurological outcome in a rat model of cardiac arrest, independent of targeted temperature management. *Circulation*, 2014 Nov 3. pii: CIRCULATIONAHA.114.011848. [Epub ahead of print].

Hayashi T, Yoshioka T, Hasegawa K, *et al* (2011): Inhalation of hydrogen gas attenuates left ventricular remodeling induced by intermittent hypoxia in mice. *Am J Physiol Heart Circ Physiol*. **301**: H1062-1069.

He B, Zhang Y, Kang B, *et al* (2013): Protection of oral hydrogen water as an antioxidant on pulmonary hypertension. *Mol Biol Rep*, **40**: 5513-5221.

He J, Xiong S, Zhang J, *et al* (2013): Protective effects of hydrogen-rich saline on ulcerative rat model. *J Surg Res*. 2013 Jun 5. pii: S0022-4804(13)00495-2. doi: 10.1016/j.jss.2013.05.047. [Epub ahead of print].

He X, Wang SY, Yin CH, *et al* (2016): Hydrogen-rich water exerting a protective effect on ovarian reserve function in a mouse model of immune premature ovarian failure induced by zona pellucida 3. *Chin Med J (Engl)*; **129**: 2331-2337.

He Y, Shi JZ, Zhang RJ, *et al* (2016): Effects of hydrogen gas inhalation on endometriosis in rats. *Reprod Sci*, 2016 Jun 23. pii: 1933719116655622. [Epub ahead of print].

Hong Y, Guo S, Chen S, *et al* (2012): Beneficial effect of hydrogen-rich saline on cerebral vasospasm after experimental subarachnoid hemorrhage in rats. *J Neurosci Res*. **90**: 1670-1680.

Hong Y, Shao A, Wang J, *et al* (2014): Neuroprotective effect of hydrogen-rich saline against neurologic damage and apoptosis in early brain injury following subarachnoid hemorrhage: Possible role of the Akt/GSK3 $\beta$  signaling pathway. *PLoS ONE*, **9**: e96212. doi. 10.1371.

Hong Y, Sun L, Sun R, *et al* (2016): Combination therapy of molecular hydrogen and hyperoxia improves survival rate and organ damage in a zymosan-induced generalized inflammation model. *Exp Ther Med*, **11**: 2590-2596.

Homma K, Yoshida T, Yamashita M, *et al* (2015): Inhalation of hydrogen gas is beneficial for preventing contrast-induced acute kidney injury in rats. *Nephron Exp Nephrol*. 2015 Jan 9. [Epub ahead of print].

Hou Z, Luo W, Sun X, *et al* (2012): Hydrogen-rich saline protects against oxidative damage and cognitive deficits after mild traumatic brain injury. *Brain Res Bull*, **88**: 560-565.

Huang CS, Kawamura T, Lee S, *et al* (2010): Hydrogen inhalation ameliorates ventilator-induced lung injury. *Crit Care* **14**: R234.

Huang CS, kawamura T, Peng X, *et al* (2011a): Hydrogen inhalation reduced epithelial apoptosis in ventilator-induced lung injury via a mechanism involving nuclear factor-kappa B activation. *Biochem Biophys Res Commun*, **408**: 253-258.

Huang G, Zhou J, Zhan W, *et al* (2013): The neuroprotective effects of intraperitoneal injection of hydrogen in rabbits with cardiac arrest. *Resuscitation* **84**: 690-695.

Huang L, Zhao S, Zhang JH, *et al* (2012): Hydrogen saline treatment attenuates hyperoxia-induced retinopathy by inhibition of oxidative stress and reduction of VEGF expression. *Ophthalmic Res*, **47**: 122-127.

Huang SL, Jiao J, Yan HW (2016): Hydrogen-rich saline attenuates steroid-associated femoral head necrosis through inhibition of oxidative stress in a rabbit model. *Exp Ther Med*, **11**: 177-182.

Huang T, Wang W, Tu C, *et al* (2015): Hydrogen-rich saline attenuates ischemia-reperfusion injury in skeletal muscle. *J Surg Res*. 194:471-80.

Huang Y, Xie K, Li J, *et al* (2011b): Beneficial effects of hydrogen gas against spinal cord ischemia-reperfusion injury in rabbits. *Brain Res*. **1378**: 125-136.

Hugyecz M, Mracsko E, Hertelendy P, *et al* (2011): Hydrogen supplemented air inhalation reduces changes of prooxidant enzyme and gap junction protein levels after transient global cerebral ischemia in the rat hippocampus. *Brain Res*, **1404**: 31-38.

Huo TT, Zeng Y, Liu XN, *et al* (2014): Hydrogen-rich saline improves survival and neurological outcome after cardiac arrest and cardiopulmonary resuscitation in rats. *Anesth Analg*, **119**: 368-380.

Igarashi T, Ohsawa I, Kobayashi M, *et al* (2016): Hydrogen prevents corneal endothelial damage in phacoemulsification cataract

surgery. *Sci Rep*, **6**: 31190.

Ignacio RM, Yoon YS, Sajo MEJ, *et al* (2013a): The balneotherapy effect of hydrogen reduced water on UVB-mediated skin injury in hairless mice. *Mol Cell Toxicol*, **9**: 15-21.

Ignacio RM, Kwak HS, Yun YU, *et al* (2013b): The drinking effect of hydrogen water on atopic dermatitis induced by *Dermatophagoides farina* allergen in NC/Nga mice. *Evid Based Complement Alternat Med*, 2013, Article ID 538673, doi: 10.1155/2013/538673. Epub 2013 Nov 20.

Iio A, Ito M, Itoh T, *et al* (2013): Molecular hydrogen attenuates fatty acid uptake and lipid accumulation through downregulating CD36 expression in HepG2 cells. *Med Gas Res*, **3**: 6

Imai K, Kotani T, Tsuda H, *et al* (2016): Neuroprotective potential of molecular hydrogen against perinatal brain injury via suppression of activated microglia. *Free Radic Bio Med*, **91**: 154-163.

Ishibashi T, Sato B, Rikitake M, *et al* (2012): Consumption of water containing a high concentration of molecular hydrogen reduces oxidative stress and disease activity in patients with rheumatoid arthritis: an open-label pilot study. *Med Gas Res*, 2012, **2**: 27.

Ishibashi T, Sato B, Shibata S, *et al* (2014): Therapeutic efficacy of infused molecular hydrogen in saline on rheumatoid arthritis: A randomized, double-blind placebo-controlled pilot study. *Int Immunopharmacol*, **21**: 468-473.

Ishibashi T, Ichikawa M, Sato B, *et al* (2015): Improvement of psoriasis-associated arthritis and skin lesions by treatment with molecular hydrogen: A report of three cases. *Mol Med Rep*, 2015 Apr 30. doi: 10.3892/mmr.2015.3707.

Itoh T, Fujita Y, Itoh M, *et al* (2009): Molecular hydrogen suppresses FcεRI-mediated signal transduction and prevents degranulation of mast cells. *Biochem Biophys Res Commun*, **389**: 651-656.

Itoh T, Hamada N, Terazawa R, *et al* (2011): Molecular hydrogen inhibits lipopolysaccharide/interferon γ-induced nitric oxide production through modulation of signal transduction in macrophages. *Biochem Biophys Res Commun*. **411**: 143-149.

Ito M, Ibi T, Sahashi K, *et al* (2011): Open-label trial and randomized, double-blind, placebo-controlled, crossover trial of hydrogen-enriched water for mitochondrial and inflammatory myopathies. *Med Gas Res*, **1**: 24.

Ito M, Hirayama M, Yamai K, *et al* (2012): Drinking hydrogen water and intermittent hydrogen gas exposure, but not lactulose or continuous hydrogen gas exposure, prevent 6-hydroxydopamine-induced Parkinson's disease in rats. *Med gas Res*, **2**: 15.

Jiang D, Wu D, Zhang Y, *et al* (2012a): Protective effects of hydrogen rich saline solution on experimental testicular ischemia-reperfusion injury in rats. *J Urol*. **187**: 2249-2253.

Jiang H, Yu P, Qian DH, *et al* (2013): Hydrogen-rich medium suppresses the generation of reactive oxygen species, elevates the Bcl-2/Bax ratio and inhibits advanced glycation end product-induced apoptosis. *Int J Mol Med*, **31**: 1381-1387.

Jing L, Wang Y, Zhao XM, *et al* (2014): Cardioprotective Effect of Hydrogen-rich Saline on Isoproterenol-induced Myocardial Infarction in Rats. *Heart Lung Circ*. 2014 Dec 4. pii: S1443-9506(14)00800-2. doi: 10.1016/j.hlc.2014.11.018. [Epub ahead of print]

Jiang Z, Xu B, Yang M, *et al* (2012b): Protective by hydrogen against gamma ray-induced testicular damage in rats. *Basic Clin Pharmacol Toxicol*. 2012 Sep 23. doi:10.1111/bcpt. 12016. [Epub ahead of print]



Ji X, Liu W, Xie K, *et al* (2010): Beneficial effects of hydrogen gas in a rat model of traumatic brain injury via reducing oxidative stress. *Brain Res.* **1354**: 196-205.

Ji X, Hui K, Zhang L, *et al* (2011): The effect of hydrogen-rich saline on the brain of rats with transient ischemia. *J Surgical Res*, **168**: e95-e101.

Ji X, Tian Y, Xie K, *et al* (2012): Protective effects of hydrogen-rich saline in a rat model of traumatic brain injury via reducing oxidative stress. *J Surg Res.* 2012 Mar 22. [Epub ahead of print]

Kagawa A, Katsura K, Mizumoto M, *et al* (2012): Influence of hydrogen discharged from palladium base hydrogen storage alloys on cancer cells. *Materials Science Forum*, **706-709**: 520-525.

Kamimura N, Ichimiya H, Iuchi K, *et al* (2016): Molecular hydrogen stimulates the gene expression of transcriptional coactivator PGC-1 $\alpha$  to enhance fatty acid metabolism. *Aging Mechanisms Disease*, **2**: 16008.

Kato R, Nomura A, Sakamoto A, *et al* (2014): Hydrogen gas attenuates embryonic gene expression and prevents left ventricular remodeling induced by intermittent hypoxia in cardiomyopathic hamsters. *Am J Physiol Heart Circ Physiol*, 2014 Oct 3; *ajheart*. 00228. 2014. doi: 10.1152/ajpheart.00228.2014. [Epub ahead of print].

Kikkawa YS, Nakagawa T, Taniguchi M, *et al* (2014): Hydrogen protects auditory hair cells from cisplatin-induced free radicals. *Neurosci Lett*, **579**: 125-129.

Kajiya M, Hasegawa G, Asano M, *et al* (2008): Supplementation of hydrogen-rich water improves lipid and glucose metabolism in patients with type 2 diabetes or impaired glucose tolerance. *Nutr Res*, **28**: 137-143.

Kajiya M, Sato K, Silva MJ, *et al* (2009a): Hydrogen from intestinal bacteria is protective for Concanavalin A-induced hepatitis. *Biochem Biophys Res Commun* **386**: 316-321.

Kajiya M, Silva MJ, Sato K, *et al* (2009b): Hydrogen mediates suppression of colon inflammation induced by dextran sodium sulfate. *Biochem Biophys Res Commun* **386**: 11-15.

Kamimura N, Nishimaki K, Ohsawa I, *et al* (2011): Molecular hydrogen improves obesity and diabetes by inducing hepatic FGF21 and stimulating energy metabolism in db/db mice. *Obesity (Silver Spring)*, **19**: 1396-1403.

Kang KM, Kang YN, Choi IB, *et al* (2011): Effects of drinking hydrogen-rich water on the quality of life of patients treated with radiotherapy for liver tumors. *Med Gas Res*, **1**: 11.

Kashiwagi T, Yan H, Hamasaki T, *et al* (2014): Electrochemically reduced water protects neural cells from oxidative damage. *Oxid Med Cell Longev*. 2014:869121. doi: 10.1155/2014/869121. Epub 2014 Oct 14.

Kasuyama K, Tomofuji T, Ekuni D, *et al* (2011): Hydrogen-rich water attenuates experimental periodontitis in a rat model. *J Clin Periodontol*. **38**: 1085-1090.

Katakura M, Hashimoto M, Tanabe Y, *et al* (2012): Hydrogen-rich water inhibits glucose and  $\alpha, \beta$ -dicarbonyl compound-induced reactive oxygen species production in the SHR,Cg-Lep<sup>crp</sup>/ND<sup>mcr</sup> rat kidney. *Med Gas Res*, **2**: 18.

Kato R, Nomura A, Sakamoto A, *et al* (2014): Hydrogen gas attenuates embryonic gene expression and prevents left ventricular remodeling induced by intermittent hypoxia in cardiomyopathic hamsters. *Am J Physiol Heart Circ Physiol.* 307:H1626-1633.

Kato S, Saitoh Y, Iwai K, *et al* (2012a): Hydrogen-rich electrolyzed warm water represses wrinkle formation against UVA ray together with type-I collagen production and oxidative-stress diminishment in fibroblasts and cell-injury prevention in keratinocytes. *J Photochem Photobiol B.* **106**: 24-33.

Kato S, Hokama R, Okayasu H, *et al* (2012b): Colloidal platinum in hydrogen-rich water exhibits radical-scavenging activity and improves blood fluidity. *J Nanosci Nanotechnol,* **12**: 4019-4027.

Kawaguchi M, Satoh Y, Otsubo Y, *et al* (2014): Molecular hydrogen attenuates neuropathic pain in mice. *PLoS ONE,* **9**: e100352.

Kawai D, Takaki A, Nakatsuka A, *et al* (2012): Hydrogen-rich water prevents progression of non-alcoholic steatohepatitis and accompanying hepatocarcinogenesis in mice. *Hepatology.* Apr 13. [Epub ahead of print].

Kawamura T, Huang CS, Tochigi N, *et al* (2010): Inhaled hydrogen gas therapy for prevention of lung transplant-induced ischemia/reperfusion injury in rats. *Transplantation,* **90**: 1344-1351.

Kawamura T, Huang CS, Peng X, *et al* (2011): The effect of donor treatment with hydrogen on lung allograft function in rats. *Surgery,* **150**: 240-249.

Kawamura T, Wakabayashi N, Shigemura N, *et al* (2013): Hydrogen gas reduced hyperoxic lung injury via the Nrf2 pathway *in vivo*.

Am J Physiol Lung Cell Mol Physiol, **304**: L646-L656.

Kawasaki H, Guan J, tamama K (2010): Hydrogen gas treatment prolongs replicative lifespan of bone marrow multipotential stromal cells in vitro while preserving differentiation and paracrine potentials. Biochem Biophys Res Commun, **397**: 608-613.

Kikkawa YS, Nakagawa T, Horie RT, *et al* (2009): Hydrogen protects auditory hair cells from free radicals. NeuroReport, **20**: 689-694.

Kishimoto Y, Kato T, Ito M, *et al* (2015): Hydrogen ameliorates pulmonary hypertension in rats by anti-inflammatory and antioxidant effects. J Thorac Cardiovasc Surg, **150**: 645-654.

Kitamura A, Kobayashi S, Matsushita T, *et al* (2010): Experimental verification of protective effect of hydrogen-rich water against cisplatin-induced nephrotoxicity in rats using dynamic contrast-enhanced CT. Br J Radiol, **83**: 509-514.

Kohama K, Yamashita H, Aoyama-Ishikawa M, *et al* (2015): Hydrogen inhalation protects against acute lung injury induced by hemorrhagic shock and resuscitation. Surgery, **158**: 399-407.

Koyama K, Tanaka Y, Saihara Y, *et al* (2008): Effect of hydrogen saturated alkaline electrolyzed water on urinary oxidative stress makers after an acute severe exercise: A randomized controlled trial. Anti-aging Med, **4**: 117-122. (in Japanese).

Koyama Y, Taura K, Hatano E, *et al* (2013): Effects of oral intake of hydrogen water on liver fibrogenesis in mice. Hepatol Res, 2013 May 20. doi: 10. 1111/hepr. 12165. [Epub ahead of print].

Kubota M, Shimura S, Kubota S, *et al* (2011): Hydrogen and N-acetyl-L-cysteine rescue oxidative stress-induced angiogenesis in a

mouse corneal alkali-burn model. *Invest Ophthalmol Vis Sci*, **52**: 427-433.

Kurioka T, Matsunobu T, Satoh Y, *et al* (2014): Inhaled hydrogen gas therapy for prevention of noise-induced hearing loss through reducing reactive oxygen species. *Neurosci Res*, 2014 Sep 6. pii: S0168-0102(14)00185-0. doi: 10. 1016/j. neures. 2014. 08. 009. [Epub ahead of print].

Lee JW, Kim JI, Lee YA, *et al* (2012): Inhaled hydrogen gas therapy for prevention of testicular ischemia/reperfusion injury in rats. *J Pediatr Surg*, **47**: 736-742.

Lee PC, Yang YY, Huang CS, *et al* (2014): Concomitant inhibition of oxidative stress and angiogenesis by chronic hydrogen-rich saline and N-acetylcysteine treatments improves systemic, splanchnic and hepatic hemodynamics of cirrhotic rats. *Hepatol Res*, 2014 Jun 24. doi: 10. 1111/hepr. 12379. [Epub ahead of print].

Lekic T, Manaenko A, Rolland W, *et al* (2011): Protective effect of hydrogen gas therapy after germinal matrix hemorrhage in neonatal rats. *Acta Neurochir Suppl*, **111**: 237-241.

Liang CX, Liu XW, Liu L, *et al* (2012): Effect of hydrogen inhalation on p38 MAPK activation in rats with lipopolysaccharide-induced acute lung injury. *Nan Fang Yi Ke Xue Bao*, **32**: 1211-1213. (in Chinese).

Li DZ1, Zhang QX, Dong XX, *et al* (2014): Treatment with hydrogen molecules prevents RANKL-induced osteoclast differentiation associated with inhibition of ROS formation and inactivation of MAPK, AKT and NF-kappa B pathways in murine RAW264.7 cells. *J Bone Miner Metab*, **32**:494-504.

Li FY, Zhu SX, Wang ZP, *et al* (2013): Consumption of hydrogen-rich water protects against ferric nitrilotriacetate-induced nephrotoxicity and early tumor promotional events in rats. *Food Chem Toxicol*, 2013 Oct 16. pii: S0278-6915(13)00679-0. doi: 10.1016/j.fct.2013.10.004. [Epub ahead of print].

Li GM, Ji MH, Sun XJ, *et al* (2012a): Effects of hydrogen-rich saline treatment on polymicrobial sepsis. *J Surg Res*. Jul 7. [Epub ahead of print].

Li H, Zhou R, Liu J, *et al* (2012b): Hydrogen-rich saline attenuates lung ischemia-reperfusion injury in rabbits. *J Surg Res*. **174**: e11-16.

Li J, Dong Y, Chen H, *et al* (2012c): Protective effects of hydrogen-rich saline in a rat model of permanent focal cerebral ischemia via reducing oxidative stress and inflammatory cytokines. *Brain Res*. 2012 Sep 23. pii: S0006-8993 (12) 01537-5. doi: 10.1016/j.brainres.2012.09.031. [Epub ahead of print].

Li J, Wang C, Zhang JH, *et al* (2010): Hydrogen-rich saline improves memory function in a rat model of amyloid-beta-induced Alzheimer's disease by reduction of oxidative stress. *Brain Res*, **1328**: 152-161.

Li J, Hong Z, Liu H, *et al* (2016a): Hydrogen-rich saline promotes the recovery of renal function after ischemia/reperfusion injury in rats via anti-apoptosis and anti-inflammation. *Front Pharmacol*, 2016 Apr 22;7: 106. doi: 10.00106. eCollection 2016.

Li J, Hong Z, Liu H, *et al* (2016b): Hydrogen-rich saline promotes the recovery of renal function after ischemia/reperfusion injury in rats via anti-apoptosis and anti-inflammation. *Front Pharmacol*, 2016 Apr 22; 7: 106. doi: 10.3389/fphar.2016.00106.eCollection 2016.

- Li Q, Kato S, Matsuoka D, *et al* (2013): Hydrogen water intake via tube-feeding for patients with pressure ulcer and its reconstructive effects on normal human skin cells *in vitro*. *Med Gas Res*, **3**:20.
- Li Q, Yu P, Zeng Q, *et al* (2016): Neuroprotective effect of hydrogen-rich saline in global cerebral ischemia/reperfusion rats: Up-regulated tregs and down-regulated miR-21, miR-210 and NF-kB expression. *Nurochem Res*, 2016 Jul 7. [Epub ahead of print].
- Li S, Lu D, Zhang Y, *et al* (2013): Long-term treatment of hydrogen-rich saline abates testicular oxidative stress induced by nicotine in mice. *J Assist Reprod Genet*, 2013 Nov 13. [Epub ahead of print].
- Li Y, Hamasaki T, Nakamichi N, *et al* (2011): Suppressive effects of electrolyzed reduced water on alloxan-induced apoptosis and type 1 diabetes mellitus. *Cytotechnol*, **63**: 119-131.
- Li Y, Xie K, Chen H, *et al* (2014): The role of Nrf2 in the hydrogen treatment for intestinal injury caused by severe sepsis. *Zhonghua Wei Zhong Bing Ji Jiu Yi Xue*, **26**: 415-419. (in Chinese).
- Li Y, Xie K, Chen H, *et al* (2015a): Hydrogen gas inhibits high-mobility group box 1 release in septic mice by upregulation of heme oxygenase 1. *J Surg Res*. **196**:136-48.
- Li Y, Li Q, Chen H, *et al* (2015b): Hydrogen gas alleviates the intestinal injury caused by severe sepsis in mice by increasing the expression of heme oxygenase-1. *Shock*. **44**: 90-98.
- Lin Y, Kashio A, Sakamoto T, *et al* (2011): Hydrogen in drinking water attenuates noise-induced hearing loss in guinea pigs. *Neurosci Lett*. **487**: 12-16.

Liu C, Kurokawa R, Fujino M, *et al* (2014): Estimation of the hydrogen concentration in rat tissue using an airtight tube following the administration of hydrogen via various routes. *Sci Rep*, **4**: 5485, doi: 10.1038/srep05485

Liu D, Wang X, Yang Y, *et al* (2014): Effects of hydrogen-rich saline on liver of severely scalded rats with delayed resuscitation. *Zhonghua Shao Shang Za Zhi*. **30**: 506-511. (in Chinese).

Liu FT, Xu SM, Xiang ZH, *et al* (2014): Molecular hydrogen suppresses reactive astrogliosis related to oxidative injury during spinal cord injury in rats. *CNS Neurosci Ther*. 2014 Mar 31. doi: 10.1111/cns.12258. [Epub ahead of print].

Liu GD, Zhang H and Liu P (2013): Molecular hydrogen regulates the expression of miR-9, miR-21 and miR-199 in LPS-activated retinal microglia cell. *Int J Ophthalmol* **6**: 280-285.

Liu H, Hua N, Xie K, *et al* (2015): Hydrogen-rich saline reduces cell death through inhibition of DNA oxidative stress and overactivation of poly (ADP-ribose) polymerase-1 in retinal ischemia-reperfusion injury. *Mol Med Rep*. 2015 May 5. doi: 10.3892/mmr.2015.3731. [Epub ahead of print]

Liu H, Liang X, Wang D, *et al* (2015): Combination therapy with nitric oxide and molecular hydrogen in a murine model of acute lung injury. *Shock*. **43**:504-511.

Liu L, Xie K, Chen H, *et al* (2014a): Inhalation of hydrogen gas attenuates brain injury in mice with cecal ligation and puncture via inhibiting neuroinflammation, oxidative stress and neuronal apoptosis. *Brain Res*, 2014 Sep 22. pii: S0006-8993(14)01251-7. doi: 10.1016/j.brainres.2014.09.030. [Epub ahead of print].



Liu L, Xie K, Chen H, *et al* (2014b): Role of Nrf2 in the protective effects of hydrogen against cerebral dysfunction in septic mice. *Zhonghua Wei Zhong Bing Ji Jiu Yi Xue*, **26**: 629-633. (in Chinese).

Liu L, Xie K, Chen H, *et al* (2015): Protective effects of inhaled hydrogen gas on cognitive function in mice with sepsis-associated encephalopathy. *DeZhonghua Yi Xue Za Zhi*, **94**:3179-3183.

Liu Q, Shen W-F, Sun H-Y, *et al* (2010): Hydrogen-rich saline protects against liver injury in rats with obstructive jaundice. *Liver International*, **30**: 958-968.

Liu Q, Li BS, Song YJ, *et al* (2016): Hydrogen-rich saline protects against mitochondrial dysfunction and apoptosis in mice with obstructive jaundice. *Mol Med Rep*, **4**: 3588-3596.

Liu R, Fang X, Meng C, *et al* (2015): Lung inflation with hydrogen during the cold ischemia phase decreases lung graft injury in rats. *Exp Biol Med (Maywood)*, **240**:1214-1222.

Liu S, Liu K, Sun Q, *et al* (2011a): Consumption of hydrogen water reduces paraquat-induced acute lung injury in rats. *J Biomed Biotechnol*, **2011**:305086. Epub 2011 Jan 24.

Liu Y, Liu W, Sun X, *et al* (2011b): Hydrogen saline offers neuroprotection by reducing oxidative stress in a focal cerebral ischemia-reperfusion rat model. *Med Gas Res*, **1**: 15.

Liu Y, Yang L, Tao K, *et al* (2014): Protective effects of hydrogen enriched saline on liver ischemia reperfusion injury by reducing oxidative stress and HMGB1 release. *BMC Gastroenterol.* 2014 Jan 12;14:12. doi: 10.1186/1471-230X-14-12.

Liu YQ, Liu YF, Ma XM, *et al* (2015): Hydrogen-rich saline attenuates skin ischemia/reperfusion induced apoptosis via regulating Bax/Bcl-2 ratio and ASK-1/JNK pathway. *J Plast Reconstr Aesthet Surg.* **68**:e147-156.

Liu X, Chen Z, Mao N, *et al* (2012): The protective of hydrogen on stress-induced gastric ulceration. *Int Immunopharmacol*, **13**: 197-203.

Liu W, Chen O, Chen C, *et al* (2011): Protective effects of hydrogen on fetal brain injury during maternal hypoxia. *Acta Neurochir Suppl*, **111**: 307-311.

Liu W, Shan LP, Dong XS, *et al* (2013): Combined early resuscitation and hydrogen inhalation attenuates lung and intestine injury. *World Gastroenterol*, **19**: 492-502.

Liu W, Dong XS, Sun YQ, *et al* (2014): A novel fluid resuscitation protocol: provide more protection on acute kidney injury during septic shock in rats. *Int J Clin Exp Med*, **7**: 919-926.

Luo ZL, Cheng L, Ren JD, *et al* (2015): Hydrogen-Rich Saline Protects against Ischemia/Reperfusion Injury in Grafts after Pancreas Transplantations by Reducing Oxidative Stress in Rats. *Mediators Inflamm.* 2015:281985. doi: 10.1155/2015/281985. Epub 2015 Mar 22

Manaenko A, Lekic T, Ma Q, *et al* (2011): Hydrogen inhalation is neuroprotective and improves functional outcomes in mice after

intracerebral hemorrhage. *Acta Neurochir Suppl.* **111**: 179-83.

Manaenko A, Lekic T, Ma Q, *et al* (2013): Hydrogen inhalation ameliorated mast cell-mediated brain injury after intracerebral hemorrhage in mice. *Crit Care Med*, **41**:1266-1275.

Mano Y, Kotani T, Ito M, *et al* (2014): Maternal molecular hydrogen administration ameliorates rat fetal hippocampal damage caused by in utero ischemia-reperfusion. *Free Radic Bio Med*, **69**: 324-330.

Mao YF, Zheng XF, Cai JM, *et al* (2009): Hydrogen-rich saline reduces lung injury induced by intestinal ischemia/reperfusion in rats. *Biochem Biophys Res Commun.* **381**: 602-605.

Matsumoto A, Yamafuji M, Tachibana T, *et al* (2013): Oral 'hydrogen water' induces neuroprotective ghrelin secretion in mice. *Sci Rep*, **3**: 3273. doi: 10. 1038. Srep03273.

Matsuno N, Watanabe R, Kimura M, *et al* (2014): Beneficial effects of hydrogen gas on porcine liver reperfusion injury with use of total vascular exclusion and active venous bypass. *Transplant Proc*, **46**:1104-1106.

Matsushita T, Kusakabe Y, Kitamura A, *et al* (2011a): Protective effect of hydrogen-rich water against gentamicin-induced nephrotoxicity in rats using blood oxygenation level-dependent MR imaging. *Magn Reson Med Sci.* **10**: 169-176.

Matsushita T, Kusakabe Y, Kitamura A, *et al* (2011b): Investigation of protective effect of hydrogen-rich water against cisplatin-induced nephrotoxicity in rats using blood oxygenation level-dependent magnetic resonance imaging. *Jpn J Radiol.* **29**: 503-512.

Mei K, Zhao S, Qian L, *et al* (2014): Hydrogen protects rats from dermatitis caused by local radiation. *J Dermatolog Treat.* **25**: 182-188.

Meng J, Yu P, Jiang H, *et al* (2016): Molecular hydrogen decelerates rheumatoid arthritis progression through inhibition of oxidative stress. *Am J Transl Res*, **8**: 4472-4477.

Meng X, Chen H, Wang G, *et al* (2015): Hydrogen-rich saline attenuates chemotherapy-induced ovarian injury via regulation of oxidative stress. *Exp Ther Med*, **10**: 2277-2282.

Miyazaki N, Yamaguchi O, Nomiya M, *et al* (2015): Preventive effect of hydrogen water on the development of detrusor overactivity in a rat model of bladder outlet obstruction. *J Urol.* 2015 Oct 27. pii: S0022-5347(15)05137-X. doi: 10.1016/j.juro.2015.10.117. [Epub ahead of print]

Muramatsu Y, Ito M, Oshima T, *et al* (2016): Hydrogen-rich water ameliorates bronchopulmonary dysplasia (BPD) in newborn rats. *Pediatr Pulmonol*, 2016 Feb 4. doi: 10. 1002/ppul. 23386. [Epub ahead of print]

Nagata K, Kamimura N, Mikami T, *et al* (2009): Consumption of molecular hydrogen prevents the stress-induced impairments in hippocampus-dependent learning tasks during chronic physical restraint in mice. *Neuropsychopharmacology*, **34**: 501-508.

Nagatani K, Wada K, Takeuchi S, *et al* (2012): Effect of hydrogen gas on the survival rate of mice following global cerebral ischemia. *Schock*, **37**: 645-652.

Nagatani K, Takeuchi S, Kobayashi H, *et al* (2013): The effect of hydrogen gas on a mouse bilateral common carotid artery occlusion. *Acta Neurochir Suppl*, **118**: 61-63.

Nakai, Y, Sato B, Ushiyama S, *et al* (2011): Hepatic oxidoreduction-related genes are upregulated by administration of hydrogen-saturated drinking water. *Biosci Biotechnol Biochem*, **75**: 774-776.

Nakao A, Kaczorowski DJ, Wang Y, *et al* (2010a): Amelioration of rat cardiac cold ischemia/reperfusion injury with inhaled hydrogen or carbon monoxide, or both. *J Heart Lung Transplant* , **29**: 544-553.

Nakao A, Toyoda Y, Sharma P, *et al* (2010b): Effectiveness of hydrogen rich water on antioxidant status of subjects with potential metabolic syndrome: an open label pilot study. *J Clin Biochem Nutr*, **46**: 140-149.

Nakashima-Kamimura N, Mori T, Ohsawa I, *et al* (2009): Molecular hydrogen alleviates nephrotoxicity induced by an anti-cancer drug cisplatin without compromising anti-tumor activity in mice. *Cancer Chemother Pharmacol*, **64**: 753-761.

Nakata K, Yamashita N, Noda Y, *et al* (2015): Stimulation of human damaged sperm motility with hydrogen molecule. *Med Gas Res*, **5** (1): 2.

Nakayama M, Kabayama S, Terawaki H, *et al* (2007): Less-oxidative hemodialysis solution rendered by cathode-side application of electrolyzed water. *Hemodialysis Int*, **11**: 322-327.

Nakayama M, Kabayama S, Nakano H, *et al* (2009): Biological effects of electrolyzed water in hemodialysis. *Nephron* **112**: C9-C15.

Nakayama M, Nakano H, Hamada H, *et al* (2010): A novel bioactive haemodialysis system using dissolved dihydrogen (H<sub>2</sub>) produced by water electrolysis: a clinical trial. *Nephrol Dial Transplant*, **25**: 3026-3033.

Ni XX, Cai ZY, Fan DF, *et al* (2011): Protective effect of hydrogen-rich saline on decompression sickness in rats. *Aviat Space Environ Med.* **82**: 604-609.

Ning Y, Shang Y, Huang H, *et al* (2013): Attenuation of cigarette smoke-induced airway mucus production by hydrogen-rich saline in rats. *PLoS ONE*, **8**: e83429. doi:10. 1371.

Noda K, Tanaka Y, Shigemura N, *et al* (2012): Hydrogen-supplemented drinking water protects cardiac allografts from inflammation-associated deterioration. *Transpl Int*, 2012 Aug 14. doi: 10. 1111/j. 1432-2227. 2012. 01542. x. [Epub ahead of print].

Noda K, Shigemura N, Tanaka Y, *et al* (2013): A novel methods of preserving cardiac grafts using a hydrogen-rich water bath. *J Heart Lung Transplant*, **32**: 241-250.

Noda K, Shigemura N, Tanaka Y, *et al* (2014): Hydrogen preconditioning during ex vivo lung perfusion improves the quality of lung grafts in rats. *Transplantation*, **98**:499-506.

Oharazawa H, Igarashi T, Yokota T, *et al* (2010): Protection of the retina by rapid diffusion of hydrogen: administration of hydrogen-loaded eye drops in retinal ischemia-reperfusion injury. *Invest Ophthalmol Vis Sci*, **51**: 487-492.

Ohsawa I, Ishikawa M, Takahashi K, *et al* (2007): Hydrogen acts as a therapeutic antioxidant by selectively reducing cytotoxic oxygen

radicals. *Nat Med*, **13**: 688-694.

Ohsawa I, Nishimaki K, Yamagata K, *et al* (2008): Consumption of hydrogen water prevents atherosclerosis in apolipoprotein E knockout mice. *Biochem Biophys Res Commun*, **377**: 1195-1198.

Okamoto A, Kohama K, Aoyama-ishikawa M, *et al* (2016): Intraperitoneally administered, hydrogen-rich physiologic solution protects against postoperative ileus and is associated with reduced nitric oxide production. *Surgery*, **160**: 623-631.

Oláh O, Tóth-Szűki V, Temesvári P, *et al* (2013): Delayed neurovascular dysfunction is alleviated by hydrogen in asphyxiated newborn pigs. *Neonatology*. **104**:79-86.

Ono H, Nishijima Y, Adachi N, *et al* (2011): Improved brain MRI indices in the acute brain stem infarct sites treated with hydroxyl radical scavengers, Edaravone and hydrogen, as compared to Edaravone alone. A non-controlled study. *Med Gas Res*, **1**: 12.

Ono H, Nishijima Y, Adachi N, *et al* (2012): Hydrogen (H<sub>2</sub>) treatment for acute erythematous skin disease. A report of 4 patients with safety data and a non-controlled feasibility study with H<sub>2</sub> concentration measurement on two volunteers. *Med Gas Res*, **2**: 14.

Ostojic SM and Stojanovic MD (2014): Hydrogen-rich water affected blood alkalinity in physically active men. *Res Sports Med*, **22**: 49-60.

Ostojic SM, Vukomanovic B, Calleja-Gonzalez J, *et al* (2014): Effectiveness of oral and topical hydrogen for sports-related soft tissue injuries. *Postgrad Med*. **126**:187-195.

- Pan Z, Zhao Y, Yu H, *et al* (2015): Effect of hydrogen-rich saline on cardiomyocyte autophagy during myocardial ischemia-reperfusion in aged rats. *Zhonghua Yi Xue Za Zhi*, **95**: 2022-2026. (in Chinese).
- Peng Z, Chen W, Wang L, *et al* (2015): Inhalation of hydrogen gas ameliorates glyoxylate-induced calcium oxalate deposition and renal oxidative stress in mice. *Int J Clin Exp Pathol*, **8**: 2680-2689.
- Qi LS, Yao L, Liu W, *et al* (2015): Sirtuin type 1 mediates the retinal protective effect of hydrogen-rich saline against light-induced damage in rats. *Invest Ophthalmol Vis Sci*, **56**: 8268-8269.
- Qian L, Cao F, Cui J, *et al* (2010a): The potential cardioprotective effects of hydrogen in irradiated mice. *J Radiat Res*. **51**: 741-747.
- Qian L, Cao F, Cui F, *et al* (2010b): Radioprotective effect of hydrogen in cultured cells and mice. *Free Rad Res*. **44**: 275-282.
- Qian L, Li B, Cao F, *et al* (2010c): Hydrogen-rich PBS protects cultured human cells from ionizing radiation-induced cellular damage. *Nucl Technol Rad Protec*. **25**: 23-29.
- Qian L, Mei K, Shen J, *et al* (2013): Administration of hydrogen-rich saline protects mice from lethal acute graft-versus-host-disease (aGVHD). *Transplantation*, **95**: 658-662.
- Qian LR and Shen JL (2016): Successful treatment with hydrogen rich water in a case of chronic graft-versus-host-disease. *Med Gas Res*, **6**: 177-179.
- Qiu XC, Jin YC, Sun Y, *et al* (2010): Effect of hydrogen-rich saline on blood pressure and antioxidant ability of lung tissue in scalded



rats following delayed resuscitation. *Zhonghua Shao Shang Za Zhi*, **26**: 435-438. (in Chinese).

Qiu X, Li H, Tang H, *et al* (2011): Hydrogen inhalation ameliorates lipopolysaccharide-induced acute lung injury in mice. *Int Immunopharmacol*. **11**: 2130-2137.

Qin ZX, Yu P, Qian DH, *et al* (2012): Hydrogen-rich saline prevents neointima formation after carotid balloon injury by suppressing ROS and the TNF- $\alpha$ /NF- $\kappa$ B pathway. *Atherosclerosis*. **220**: 343-350.

Qu J, Gan YN, Xie KL, *et al* (2012a): Inhalation of hydrogen gas attenuates ouabain-induced auditory neuropathy in gerbils. *Acta Pharmacol Sin*. **33**: 445-451.

Qu J, Li X, Wang J, *et al* (2012b): Inhalation of hydrogen gas attenuates cisplatin-induced ototoxicity via reducing oxidative stress. *Int J Pediatr Otorhinolaryngol*. **76**: 111-115.

Ren J, Luo Z, Tian F, *et al* (2012): Hydrogen-rich saline reduces the oxidative stress and relieves the severity of trauma-induced acute pancreatic in rats. *J Trauma Acute Care Surg*, **72**: 1555-1561.

Ren JD, Ma J, Hou J, *et al* (2014): Hydrogen-rich saline inhibits NLRP3 inflammasome activation and attenuates experimental acute pancreatitis in mice. *Med Inflamm*, **2014**: Article ID 930894.

Runtuwene J, Amitani H, Amitani M, *et al* (2015): Hydrogen-water enhances 5-fluorouracil-induced inhibition of colon cancer. *PeerJ*, **3**: e859; DOI 10.7717/peerj.859.

Saitoh Y, Okayasu H, Xiao L, *et al* (2008): Neutral pH hydrogen-enriched electrolyzed water achieves tumor-preferential clonal growth inhibition over normal cells and tumor invasion inhibition concurrently with intracellular oxidant repression. *Oncol Res.* **17**: 247-255.

Saitoh Y, Yoshimura Y, Nakano K, *et al* (2009): Platinum nanocolloid-supplemented hydrogen-dissolved water inhibits growth of human tongue carcinoma cells preferentially over normal cells. *Exp Oncol*, **31**: 156-162.

Sakai K, Cho S, Shibata I, *et al* (2012): Inhalation of hydrogen gas protects against myocardial stunning and infarction in swine. *Scand Cardiovasc J*, **46**: 183-189.

Sakai T, Sato B, Hara K, *et al* (2014): Consumption of water containing over 3.5 mg of dissolved hydrogen could improve vascular endothelial function. *Vas Health Risk Manage*, **2014**: 10:591-597.

Sato Y, Kajiyama S, Amano A, *et al* (2008): Hydrogen-rich pure water prevents superoxide formation in brain slices of vitamin C-depleted SMP30/GNL knockout mice. *Biochem Biophys Res Commun.* **375**: 346-350.

Shao A, Wu H, Hong Y, *et al* (2015): Hydrogen-Rich Saline Attenuated Subarachnoid Hemorrhage-Induced Early Brain Injury in Rats by Suppressing Inflammatory Response: Possible Involvement of NF- $\kappa$ B Pathway and NLRP3 Inflammasome. *Mol Neurobiol.* 2015 Jun 20. [Epub ahead of print]

Shen L, Wang J, Liu K, *et al* (2011): Hydrogen-rich saline is cerebroprotective in a rat model of deep hypothermic circulatory arrest. *Neurochem Res*, **36**: 1501-1511.

Shen MH, Cai JM, Sun Q, *et al* (2013): Neuroprotective effect of hydrogen-rich saline in acute carbon monoxide poisoning. *CNS Neurosci Ther.* **19**: 361-363.

Sheng Q, Lv Z, Cai W, *et al* (2013): Protective effects of hydrogen-rich saline on necrotizing enterocolitis in neonatal rats. *J Pediatr Surg.* **48**: 1697-1706.

Shi HM, Zhou HC, Jia YR, *et al* (2013): The effect of hydrogen on hemorrhagic shock induced acute lung injury in rats. *Zhonghua Wei Zhong Bing Ji Jiu Yi Xue*, **25**:347-350. (in Chinese).

Shi J, Yao F, Zhong C, *et al* (2012): Hydrogen saline is protective for acute lung ischemia/reperfusion injuries in rats. *Heart Lung Circ.* **21**: 556-563.

Shi Q, Liao KS, Zhao KL, *et al* (2015): Hydrogen-rich saline attenuates acute renal Injury in sodium taurocholate-induced severe acute pancreatitis by inhibiting ROS and NF- $\kappa$ B pathway. *Mediators Inflamm.* 2015:685043. doi: 10.1155/2015/685043. Epub 2015 Mar 23

Shi Q, Chen C, Deng WH, *et al* (2016): Hydrogen-rich saline attenuates acute hepatic injury in acute necrotizing pancreatitis by inhibiting inflammation and apoptosis, involving JNK and p38 mitogen-activated protein kinase-dependent reactive oxygen species. *Pancreas*, **45**: 1424-1431.

Shigeta T, Sakamoto S, Li XK, *et al* (2015): Luminal injection of hydrogen-rich solution attenuates intestinal ischemia-reperfusion injury in rats. *Transplantation.* **99**: 500-507.

Shinbo T, Kokubo K, Sato Y, *et al* (2013): Breathing nitric oxide plus hydrogen gas reduces ischemia-reperfusion injury and nitrotyrosine production in murine heart. *Am J Physiol Heart Circ Physiol*, **305**: H542-H550.

Shingu C, Koga H, Hagiwara S, *et al* (2010): Hydrogen-rich saline solution attenuates renal ischemia-reperfusion injury. *J Anesth*. **24**: 569-574.

Shu RC, Zhang LL, Wang CY, *et al* (2015): Spinal peroxynitrite contributes to remifentanyl-induced postoperative hyperalgesia via enhancement of divalent metal transporter 1 without iron-responsive element-mediated iron accumulation in rats. *Anesthesiology*. **122**: 908-920.

Sobue S, Yamai K, Ito M, *et al* (2015): Simultaneous oral and inhalational intake of molecular hydrogen additively suppresses signaling pathways in rodents. *Mol Cell Biochem*. 2015 May;403(1-2):231-41. doi: 10.1007/s11010-015-2353-y. Epub 2015 Feb 24.

Song G, Tian H, Liu J, *et al* (2011): H<sub>2</sub> inhibits TNF- $\alpha$ -induced lectin-like oxidized LDL receptor-1 expression by inhibiting nuclear factor  $\kappa$ B activation in endothelial cells. *Biotechnol Lett*, **33**: 1715-1722.

Song G, Tian H, Qin S, *et al* (2012): Hydrogen decreases athero-susceptibility in apolipoprotein B-containing lipoproteins and aorta of apolipoprotein E knockout mice. *Atherosclerosis*, **221**: 55-65.

Song G, Li M, Sang H, *et al* (2013): Hydrogen-rich water decrease serum low-density lipoprotein cholesterol levels and improves high-density lipoprotein function in patients with potential metabolic syndrome. *J Lipid Res*, 2013 Apr 22. [Epub ahead of print].

Song G, Zong C, Zhang Z, *et al* (2015a): Molecular hydrogen stabilizes atherosclerotic plaque in low-density lipoprotein receptor-knockout mice. *Free Radic Biol Med.* 2015 Oct;87:58-68. doi: 10.1016/j.freeradbiomed.2015.06.018. Epub 2015 Jun 25.

Song G, Lin Q, Zhao H, *et al* (2015b): Hydrogen activates ATP-binding cassette transporter A1-dependent efflux *ex vivo* and improves high-density lipoprotein function in patients with hypercholesterolemia: A double-blinded, randomized, and placebo-controlled trial. *J Clin Endocrinol Metab.* **100**: 2724-2733.

Song Y, Chen F, Xiong J, *et al* (2013): A study on residual strain of abdominal aortic aneurysm after intraperitoneal administration of saturated hydrogen saline in rats. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi*, **27**: 881-884. (in Chinese).

Spulber S, Edoff K, Hong L, *et al* (2012): Molecular hydrogen reduces LPS-induced neuroinflammation and promotes recovery from sickness behaviour in mice. *PLoS One*, **7**: e42078.

Sun JC, Xu T, Zuo Q, *et al* (2014): Hydrogen-rich saline promotes survival of retinal ganglion cells in a rat model of optic nerve crush. *PLoS ONE*, **9**: e99299.

Sun Q, Kang Z, Cai J, *et al* (2009): Hydrogen-rich saline protects myocardium against ischemia/reperfusion injury in rats. *Exp Biol Med*, **234**: 1212-1219.

Sun H, Chen L, Zhou W, *et al* (2011a): The protective role of hydrogen-rich saline in experimental liver injury in mice. *J Hepatol*, **54**: 471-480.

Sun Q, Cai J, Zhou J, *et al* (2011b): Hydrogen-rich saline reduces delayed neurologic sequelae in experimental carbon monoxide

toxicity. Crit Care Med. **39**: 765-769.

Sun Q, Cai J, Liu S, *et al* (2011c): Hydrogen-rich saline provides protection against hyperoxic lung injury. J Surg Res. **165**: e43-49.

Sun Q, Kawamura T, Masutani K, *et al* (2012a): Oral intake of hydrogen-rich water inhibits intimal hyperplasia in arterialized vein grafts in rats. Cardiovasc Res. **94**: 144-153.

Sun Y, Shuang F, Chen DM, *et al* (2012b): Treatment of hydrogen molecule abates oxidative stress and alleviates bone loss induced by modeled microgravity in rats. Osteoporos Int, May 31. [Epub ahead of print].

Takaenoki Y, Satoh Y, Araki Y, *et al* (2014): Neonatal exposure to sevoflurane in mice causes deficits in maternal behavior later in adulthood. Anesthesiology. **120**: 403-415.

Takeuchi S, Wada K, Nagatani K, *et al* (2012): Hydrogen may inhibit collagen-induced platelet aggregation: An *ex vivo* and *in vivo* study. Intern Med, **51**: 1309-1313.

Takeuchi S, Nagatani K, Otani N, *et al* (2015): Hydrogen improves neurological function through attenuation of blood-brain barrier disruption in spontaneously hypertensive stroke-prone rats. BMC Neurosci, Apr 20;16 (1):22. doi: 10.1186/s12868-015-0165-3.

Tamaki N, Orihuela-Campos RC, Fukui M, *et al* (2016): Hydrogen-rich water intake accelerates oral palatal wound healing via activation of the Nrf2/antioxidant defense pathways in a rat model. Oxid Med Cell Long, **2016**: Article ID 5679040.

Tamura T, Hayashida K, Sano M, *et al* (2016): Feasibility and safety of hydrogen gas inhalation for post-cardiac arrest syndrome. – First-in-human pilot study - . *Circ J*, **80**: 1870-1873.

Tan M, Sun X, Guo L, *et al* (2013): Hydrogen as additive of HTK solution fortifies myocardial preservation in grafts with prolonged cold ischemia. *Int J Cardiol*, **167**: 383-390.

Tan YC, Xie F, Zhang HL, *et al* (2014): Hydrogen-rich saline attenuates postoperative liver failure after major hepatectomy in rats. *Clin Res Hepatol Gastroenterol*, 2014 Feb 3. pii: S2210-7401(13)00265-9. doi: 10. 1016/j. clinre. 2013.11.007. [Epub ahead of print].

Tange Y, Takesawa S, Yoshitake S (2015): Dialysate with high dissolved hydrogen facilitates dissociation of indoxyl sulfate from albumin. *Nephrourol Mon*. **7**: e26847.

Tanaka Y, Shigemura N, Kawamura T, *et al* (2012): Profiling molecular changes induced by hydrogen treatment of lung allografts prior to procurement. *Biochem Biophys Res Commun*, **425**:873-879.

Tao B, Liu L, Wang N, *et al* (2015): Hydrogen-rich saline attenuates lipopolysaccharide-induced heart dysfunction by restoring fatty acid oxidation in rats by mitigating C-Jun N-terminal kinase activation. *Shock*, **44**: 593-600.

Tao B, Liu L, Wang N, *et al* (2016): Effects of hydrogen-rich saline on aquaporin 1, 5 in septic rat lungs. *J Surg Res*, **202**: 291-298.

Taura A, Kikkawa YS, Nakagawa T, *et al* (2010): Hydrogen protects vestibular hair cells from free radicals. *Acta Otolaryngologica*, **130**: 95-100.

Terasaki Y, Ohsawa I, Terasaki M, *et al* (2011): Hydrogen therapy attenuates irradiation-induced lung damage by reducing oxidative stress. *Am J Physiol*, **301**: L415-L426.

Terawaki H, Hayashi Y, Zhu WJ, *et al* (2013): Transperitoneal administration of dissolved hydrogen for peritoneal dialysis patients: a novel approach to suppress oxidative stress in the peritoneal cavity. *Med Gas Res*, **3**: 14.

Terawaki H, Zhu WJ, Matsuyama Y, *et al* (2014): Effect of hydrogen (H<sub>2</sub>)-enriched solution on the albumin redox of hemodialysis patients. *Hemodial Int*, **18**: 459-466.

Terawaki H, Nakano H, Zhu WJ, *et al* (2015): Successful treatment of encapsulating peritoneal sclerosis by hemodialysis and peritoneal lavage using dialysate containing dissolved hydrogen. *Perit Dial Int*, **35**:107-112.

Tian L, Zhang L, Xia F, *et al* (2013): Hydrogen-rich saline ameliorates the retina against light-induced damage in rats. *Med Gas Res*, **3**: 19.

Tian R, Hou Z, Hao S, *et al* (2016): Hydrogen-rich water attenuates brain damage and inflammation after traumatic brain injury in rats. *Brain Res*, **1637**: 1-13.

Tian Y, Guo S, Zhang Y, *et al* (2016): Effects of hydrogen-rich saline on hepatectomy-induced postoperative cognitive dysfunction in old mice. *Mol Neurobiol*, 2016 Mar 19. [Epub ahead of print]

Tomofuji T, Kawabata Y, Kasuyama K, *et al* (2014): Effects of hydrogen-rich water on aging periodontal tissues in rats. *Sci Rep*, **4**: 5534, doi: 10. 1038/srep05534.



Tsubone H, Hanafusa M, Endo M, *et al* (2013): Effect of treadmill exercise and hydrogen-rich water intake on serum oxidative and anti-oxidative metabolites in serum of thoroughbred horses. *J Equine Sci*, **24**: 1-8.

Ushida T, Kotani T, Tsuda H, *et al* (2016): Molecular hydrogen ameliorates several characteristics of preeclampsia in the reduced uterine perfusion pressure (RUPP) rat model. *Free Radic Biol Med*, 2016 Oct 24. pii: S0891-5849(16)30978-9.doi: 10.1016/j.freeradbiomed.2016.10.481. [Epub ahead of print].

Wang C, Li J, Liu Q, *et al* (2011a): Hydrogen-rich saline reduces oxidative stress and inflammation by inhibit of JNK and NF- $\kappa$ B activation in a rat model of amyloid-beta-induced Alzheimer's disease. *Neurosci Lett*. **491**: 127-132.

Wang F, Yu G, Liu SY, *et al* (2011b): Hydrogen-rich saline protects against renal ischemia/reperfusion injury in rats. *J Surg Res*. **167**: e339-344.

Wang JL, Zhang QS, Zhu KD, *et al* (2015): Hydrogen-rich saline injection into the subarachnoid cavity within 2 weeks promotes recovery after acute spinal cord injury. *Neural Regen Res*, **10**: 958-964.

Wang P, Jia L, Chen B, *et al* (2016): Hydrogen inhalation is superior to mild hypothermia in improving cardiac function and neurological outcome in an asphyxia cardiac arrest model of rats. *Shock*, 2016 Feb 3. [Epub ahead of print].

Wang R, Wu J, Chen Z, *et al* (2016): Postconditioning with inhaled hydrogen promotes survival of retinal ganglion cells in a rat model of retinal ischemia/reperfusion injury. *Brain Res*, 2016 Feb 1; 1632: 82-90. doi: 10.1016/j.brainres.2015.12.015. Epub 2015 Dec 17.

- Wang T, Zhao L, Liu M, *et al* (2014): Oral intake of hydrogen-rich water ameliorated chlorpyrifos-induced neurotoxicity in rats. *Toxicol App Pharmacol*, **280**: 169-176.
- Wang Y, Jing L, Zhao XM, *et al* (2011c): Protective effects of hydrogen-rich saline on monocrotaline-induced pulmonary hypertension in a rat model. *Respir Res*. **12**: 26.
- Wang W, Tian L, Li Y, *et al* (2012a): Effects of hydrogen-rich saline on rats with acute carbon monoxide poisoning. *J Emerg Med*. 2012 Aug 14. [Epub ahead of print].
- Wang QJ, Zha XJ, Kang ZM, *et al* (2012b): Therapeutic effects of hydrogen saturated saline on rat diabetic model and insulin resistant model via reduction of oxidative stress. *Chin Med J (Engl)*: **125**: 1633-1637.
- Wang W, Li Y, Ren J, *et al* (2012c): Hydrogen rich saline reduces immune-mediated brain injury in rats with acute carbon monoxide poisoning. *Neurol Res*, **34**: 1007-1015.
- Wang X, Yu P, Yong Y, *et al* (2015): Hydrogen-rich saline resuscitation alleviates inflammation induced by severe burn with delayed resuscitation. *Burns*, **41**: 379-85.
- Watanabe S, Fujita M, Ishihara M, *et al* (2014): Protective effects of inhalation of hydrogen gas on radiation-induced dermatitis and skin injury in rats. *J Rad Res*, 2014: 1-7, doi: 10. 1093/jrr067.
- Wei L, Ge L, Qin S, *et al* (2012): Hydrogen-rich saline protects retina against glutamate-induced excitotoxic injury in guinea pig. *Exp Eye Res*. **94**: 117-127.

Wei R, Zhang R, Xie Y, *et al* (2015): Hydrogen suppresses hypoxia/reoxygenation-induced cell death in hippocampal neurons through reducing oxidative stress. *Cell Physiol Biochem.* **36**: 585-598.

Wu S, Zhu L, Yang J, *et al* (2014): Hydrogen-containing saline attenuates doxorubicin-induced heart failure in rats. *Pharmazie*, **69**: 633-636.

Wu F, Qiu Y, Ye G, *et al* (2015): Treatment with hydrogen molecule attenuates cardiac dysfunction in streptozotocin-induced diabetic mice. *Cardiovasc Pathol.*, 24:294-303.

Xiang L, Tan JW, Huang LJ, *et al* (2012): Inhalation of hydrogen gas reduces liver injury during major hepatectomy in swine. *World J Gastroenterol* **18**: 5197-5204.

Xie K, Wang W, Chen H, *et al* (2015): Hydrogen-Rich medium attenuated lipopolysaccharide-induced monocyte-endothelial cell adhesion and vascular endothelial permeability via rho-associated coiled-coil protein kinase. *Shock.* **44**: 58-64.

Xu B, Zhang YB, Li ZZ, *et al* (2013): Hydrogen-rich saline ameliorates renal injury induced by unilateral ureteral obstruction in rats. *Int Immunopharmacol.* **17**: 447-452.

Xu XF, and Zhang J (2013): Saturated hydrogen saline attenuates endotoxin-induced acute liver dysfunction in rats. *Physiol Res*, **62**: 395-403.

Xu Z, Zhou J, Cai J, *et al* (2012): Anti-inflammation effects of hydrogen saline in LPS activated macrophages and carrageenan induced

paw edema. *J Inflammation*, **9**: 2.

Xue J, Shang G, Tanaka Y, *et al* (2014): Dose-dependent inhibition of gastric injury by hydrogen in alkaline electrolyzed drinking water. *BMC Complement Altern Med*, **14**: 81

Xia C, Liu W, Zeng D, *et al* (2013): Effect of hydrogen-rich water on oxidative stress, liver function, and viral load in patients with chronic hepatitis B. *Clin Trans Sci*, **6**: 372-375.

Xiao L and Miwa N (2016): Hydrogen-rich water achieves cytoprotection from oxidative stress injury in human gingival fibroblasts in culture or 3D-tissue equivalents, and wound-healing promotion, together with ROS-scavenging and relief from glutathione diminishment. *Hum Cell*, 2016 Nov 1. [Epub ahead of print].

Xiao M, Zhu T, Wang T, *et al* (2013): Hydrogen-rich saline reduces airway remodeling via inactivation of NF- $\kappa$ B in a murine model of asthma. *Eur Rev Med Pharmacol Sci*, **17**: 1033-1043.

Xiao X, Cai J, Xu J, *et al* (2012): Protective effects of hydrogen saline on diabetic retinopathy in a streptozotocin-induced diabetic rat model. *J Ocul Pharmacol Ther*. **28**:76-82.

Xie K, Yu Y, Pei Y, *et al* (2010a): Protective effects of hydrogen gas on murine polymicrobial sepsis via reducing oxidative stress and HMGB1 release. *Shock*, **34**: 90-97.

Xie K, Yu Y, Zhang Z, *et al* (2010b): Hydrogen gas improves survival rate and organ damage in zymosan-induced generalized inflammation model. *Shock*, **34**: 495-501.

Xie K, Yu Y, Huang Y, *et al* (2012a): Molecular hydrogen ameliorates lipopolysaccharide-induced acute lung injury in mice through reducing inflammation and apoptosis. *Shock*. **37**: 548-55.

Xie K, Fu W, Xing W, *et al* (2012b): Combination therapy with molecular hydrogen and hyperoxia in a murine model of polymicrobial sepsis. *Shock*, **38**: 655-663.

Xie K<sup>1</sup>, Wang W, Chen H, *et al* (2015): Hydrogen-rich medium attenuated lipopolysaccharide-induced monocyte-endothelial cell adhesion and vascular endothelial permeability via Rho-associated coiled-coil protein kinase. *Shock*. **44**: 58-64.

Xie Q, Li XX, Zhang P, *et al* (2014): Hydrogen gas protects against serum and glucose deprivation-induced myocardial injury in H9c2 cells through activation of the NF-E2-related factor 2/heme oxygenase 1 signaling pathway. *Mol Med Rep*. **10**:1143-1149.

Xin HG, Zhang BB, Wu ZQ, *et al* (2014): Consumption of hydrogen-rich water alleviates renal injury in spontaneous hypertensive rats. *Mol Cell Biochem*, 2014 Mar 21. [Epub ahead of print].

Yamada T, Uchida K, Onuma K, *et al* (2014): Hydrogen supplementation of preservation solution improves viability of osteochondral grafts. *The Sci World J*, **2014**: Article ID 109876.

Yamazaki M, Kusano K, Ishibashi T, *et al* (2015): Intravenous infusion of H<sub>2</sub>-saline suppresses oxidative stress and elevates antioxidant potential in thoroughbred horses after racing exercise. *Sci Rep*, **5**: 15514; DOI 10.1038/srep15514.

Yan H, Tian H, Kinjo T, *et al* (2010): Extension of the lifespan of *Caenorhabditis elegans* by the use of electrolyzed reduced water.

Biosci Biotechnol Biochem, **74**: 2011-2015.

Yanagihara T, Arai K, Miyamae K, *et al* (2005): Electrolyzed hydrogen-saturated water for drinking use elicits an antioxidative effect: A feeding test with rats. Biosci Biotechnol Biochem, **69**: 1985-1987.

Yang CX, Yan H, Ding TB, *et al* (2013): Hydrogen saline prevents selenite-induced cataract in rats. Molecular Vision, **19**: 1684-1693.

Yonamine R, Satoh Y, Kodama M, *et al* (2013): Co-administration of hydrogen gas as part of the carrier gas mixture suppresses neuronal apoptosis and subsequent behavioral deficits caused by neonatal exposure to sevoflurane in mice. Anesthesiology, **118**: 105-113.

Yang X, Guo L, Sun X, *et al* (2011): Protective effects of hydrogen-rich saline in preeclampsia rat model. Placenta. **32**: 681-686.

Yang Y, Li B, Liu C, *et al* (2012): Hydrogen-rich saline protects immunocytes from radiation-induced apoptosis. Med Sci Monit. **18**: BR144-148.

Yang Y, Gao F, Zhang H, *et al* (2013): Molecular hydrogen protects human lymphocyte AHH-1 cells against 12C6+ heavy ion radiation. Int J Radiat Biol, **89**:1003-1008.

Ye J, Li Y, Hamasaki T, *et al* (2008): Inhibitory effect of electrolyzed reduced water on tumor angiogenesis. Biol Pharm Bull, **31**: 19-26.

Yokota T, Kamimura N, Igarashi T, *et al* (2015): Protective effect of molecular hydrogen against oxidative stress caused by peroxynitrite derived from nitric oxide in rat retina. Clin Experiment Ophthalmol, 2015 Mar 20. doi: 10.1111/ceo. 12525. [Epub ahead

of print].

Yoon KS, Huang XZ, Yoon YS, *et al* (2011a): Histological study on the effect of electrolyzed reduced water-bathing on UVB radiation-induced skin injury in hairless mice. *Biol Pharm Bull*, **34**: 1671-1677.

Yoon YS, Kim DH, Kim SK, *et al* (2011b): The melamine excretion effect of the electrolyzed reduced water in melamine-fed mice. *Food Chem Toxicol*, **49**: 1814-1819.

Yoon YS, Sajo ME, Ignacio RM, *et al* (2014): Positive effects of hydrogen water on 2,4-dinitrochlorobenzene-induced atopic dermatitis in NC/Nga mice. *Bio Pharm Bull*, 2014; 37 (9): 1480-1485.

Yoritaka A, Takanashi M, Hirayama M, *et al* (2013): Pilot study of H<sub>2</sub> therapy in Parkinson's disease. A randomized double-blind placebo-controlled trial. *Mov Disord*, **28**: 836-839.

Yoshida A, Asanuma H, Sasaki H, *et al* (2012): H<sub>2</sub> mediates cardioprotection via involvements of K<sub>ATP</sub> channels and permeability transition pores of mitochondria in dogs. *Cardiovasc Drugs Ther*, **26**: 217-226.

Yu J, Zhang W, Zhang R, *et al* (2015): Molecular hydrogen attenuates hypoxia/reoxygenation injury of intrahepatic cholangiocytes by activating Nrf2 expression. *Toxicol Lett*, **238**: 11-19.

Yu P, Wang Z, Sun X, *et al* (2011): Hydrogen-rich medium protects human skin fibroblasts from high glucose or mannitol induced oxidative damage. *Biochem Biophys Res Commun*, **409**: 350-355.

- Yu Y, Wang WN, Han HZ, *et al* (2015): Protective effects of hydrogen-rich medium on lipopolysaccharide-induced monocytic adhesion and vascular endothelial permeability through regulation of vascular endothelial cadherin. *Genet Mol Res*, **14**: 6202-6212.
- Yu YS, and Zheng H. (2012): Chronic hydrogen-rich saline treatment reduces oxidative stress and attenuates left ventricular hypertrophy in spontaneous hypertensive rats. *Mol Cell Biochem*. **365**: 233-242.
- Yu J, Zhang W, Zhang R, *et al* (2015): Lactulose accelerates liver regeneration in rats by inducing hydrogen. *J Surg Res*. **195**:128-135.
- Yuan L, Chen X, Qian L, *et al* (2015): Administration of hydrogen-rich saline in mice with allogeneic hematopoietic stem-cell transplantation. *Med Sci Monit*. **21**:749-754.
- Yuan J, Wang D, Liu Y, *et al* (2016): Effects of hydrogen rich water on the expression of Nrf 2 and the oxidative stress in rats with traumatic brain injury. *Chin Crit Care Med*, **27**: 911-915. (in Chinese).
- Zeng K, Huang H, Jiang XQ, *et al* (2014): Protective effects of hydrogen on renal ischemia/reperfusion injury in rats. *Sichuan Da Xue Xue Bao Yi Xue Ban*, **45**: 39-41. (in Chinese).
- Zhai Y, Zhou X, Dai Q, *et al* (2015): Hydrogen-rich saline ameliorates lung injury associated with cecal ligation and puncture-induced sepsis in rats. *Exp Mol Pathol*. **98**:268-276.
- Zhang Y, Sun Q, He B, *et al* (2011): Anti-inflammatory effect of hydrogen-rich saline in a rat model of regional myocardium ischemia and reperfusion. *Int J Cariol*, **148**: 91-95.



Zhan Y, Chen C, Suzuki H, *et al* (2012): Hydrogen gas ameliorates oxidative stress in early brain injury after subarachnoid hemorrhage in rats. *Crit Care Med.* **40**: 1291-1296.

Zhang CB, Tang YC, Xu XJ, *et al* (2015): Hydrogen gas inhalation protects against liver ischemia/reperfusion injury by activating the NF- $\kappa$ B signaling pathway. *Exp Ther Med.* **9**:2114-2120.

Zhang DQ and Zhu JH (2012): Experimental studies of effects of hydrogen-rich saline in rats with severe acute pancreatitis. *Zhonghua Yi Xue Za Zhi*, **92**: 2436-2440. (in Chinese).

Zhang DQ, Feng H, and Chen WC (2013): Effects of hydrogen-rich saline on taurocholate-induced acute pancreatitis in rat. *Evid Based Complement Alternat Med*, **2013**: 731932. doi: 10.1155/2013/731932. [Epub ahead of print].

Zhang G, Gao S, Li X, *et al* (2015): Pharmacological postconditioning with lactic Acid and hydrogen rich saline alleviates myocardial reperfusion injury in rats. *Sci Rep.* 2015 Apr 30;5:9858. doi: 10.1038/srep09858

Zhang J, Wu Q, Song S, *et al* (2014): Effect of hydrogen-rich water on acute peritonitis of rat models. *Int Immunopharmacol*, 2014 Apr 29. pii: S1567-5769(14)00147-7. doi: 10.1016/j.intimp.2014.04.011. [Epub ahead of print].

Zhang JY, Wu QF, Wan Y, *et al* (2013): Protective role of hydrogen-rich water on aspirin-induced gastric mucosal damage in rats. *World J Gastroenterol*, **20**: 1614-1622.

Zhang JY, Song SD, Pang Q, *et al* (2015): Hydrogen-rich water protects against acetaminophen-induced hepatotoxicity in mice. *World J Gastroenterol*, **21**:4195-209.

Zhang L, Shu R, Wang H, *et al* (2014a): Hydrogen-rich saline prevents remifentanil-induced hyperalgesia and inhibits MnSOD nitration via regulation of NR2B-containing NMDA receptor in rats. *Neuroscience*, 2014 Sep 18; 280C: 171-180. doi: 10.1016/j.neuroscience.2014.09.024. [Epub ahead of print].

Zhang L, Shu R, Wang C, *et al* (2014b): Hydrogen-rich saline controls remifentanil-induced hypernociception and NMDA receptor NR1 subunit membrane trafficking through GSK-3 $\beta$  in the DRG in rats. *Brain Res Bull*, **106**: 47-55.

Zhang Q, Tao Y, Zhang ZM (2016): Hydrogen-rich saline is ineffective in oxygen-induced retinopathy. *Life Sci*, 2016 Apr 14, pii: S0024-3205(16)30236-3. doi: 10.1016/j.lfs.2016.04.015. [Epub ahead of print].

Zhang Y, Liu Y, Zhang J (2015): Saturated saline attenuates endotoxin-induced lung dysfunction. *J Surg Res*, **198**: 41-49.

Zhang Y, Li H, Yang C, *et al* (2015): Treatment with hydrogen-rich saline delays disease progression in a mouse model of amyotrophic lateral sclerosis. *Neurochem Res*, 2015 Nov 4. [Epub ahead of print].

Zhang Y, Su WJ, Chen Y, *et al* (2016): Effects of hydrogen-rich water on depressive-like behavior in mice. *Sci Rep*, **6**: 23742.

Zhang YG, Sheng QS, Wang ZJ, *et al* (2015): Hydrogen-rich saline promotes motor functional recovery following peripheral nerve autografting in rats. *Exp Ther Med*, **10**: 727-732.

Zhang YX, Xu JT, You XC, *et al* (2016): Inhibitory effects of hydrogen on proliferation and migration of vascular smooth muscle cells via down-regulation of mitogen/activated protein kinase and ezrin-radixin-signaling pathways. *Chin J Physiol*, **59**: 46-55.

Zhao L, Zhou C, Zhang J, *et al* (2011): Hydrogen protects mice from radiation induced thymic lymphoma in BALB/c mice. *Int J Bio Sci*, **7**: 297-300.

Zhao L, Wang YB, Qin SR, *et al* (2013): Protective effect of hydrogen-rich saline on ischemia/reperfusion injury in rat skin flap. *J Zhejiang Univ Sci B*, **14**: 382-391.

Zhao L, Chen X, Dai Q, *et al* (2015): Role of FOXO3a in process of hydrogen-rich saline attenuating global cerebral ischemia-reperfusion injury in rats. *Zhonghua Yi Xue Za Zhi*, **95**: 457-461. (in Chinese).

Zhao M, Liu MD, Pu YY, *et al* (2016): Hydrogen-rich water improves neurological function recovery in experimental autoimmune encephalomyelitis mice. *J Neuroimmunol*, **294**: 6-13.

Zhao S, Mei K, Qian L, *et al* (2013): Therapeutic effects of hydrogen-rich solution on aplastic anemia *in vivo*. *Cell Physiol Biochem*, **32**: 549-560.

Zhao S, Yang Y, Liu W, *et al* (2014): Protective effect of hydrogen-rich saline against radiation-induced immune dysfunction. *J Cell Mol Med, J Cell Mol Med*, 2014 Mar 12. doi: 10.1111/jcmm. 12245. [Epub ahead of print].

Zhao Y, Tang Y, Suo C, *et al* (2014): Effects of hydrogen-rich saline on endoplasmic reticulum stress during myocardial ischemia-reperfusion in rats. *Zhonghua Yi Xue Za Zhi*. 94:3024-3028. (in Chinese).

Zheng H, and Yu YS. (2012): Chronic hydrogen-rich saline treatment attenuates vascular dysfunction in spontaneous hypertensive

rats. *Biochem Pharmacol.* **83**: 1269-1277.

Zheng X, Mao Y, Cai J, *et al* (2009): Hydrogen-rich saline protects against intestinal ischemia/reperfusion injury in rat. *Free Rad Res*, **43**: 478-484.

Zheng J, Liu K, Kang Z, *et al* (2010): Saturated hydrogen saline protects the lung against oxygen toxicity. *Undersea Hyperb Med*, **37**: 185-192.

Zhou J, Chen Y, Huang GQ, *et al* (2012a): Hydrogen-rich saline reverses oxidative stress, cognitive impairment, and mortality in rats submitted to sepsis by cercal ligation and puncture. *J Surg Res*. 2012 Apr 1. [Epub ahead of print].

Zhou L, Wang X, Xue W, *et al* (2013): Beneficial effects of hydrogen-rich saline against spinal cord ischemia-reperfusion injury in rabbits. *Brain Res*, 2013 Apr 17, doi: 10. 1016/j. brainres. 2013. 04. 007. [Epub ahead of print].

Zhou Y, Zheng H, Ruan F, *et al* (2012b): Hydrogen-rich saline alleviates experimental noise-induced hearing loss in guinea pigs. *Neuroscience*. **209**: 47-53.

Zhou H, Fu Z, Wei Y, *et al* (2013): Hydrogen inhalation decrease lung graft injury in brain-dead donor rats. *J Heart Lung Transplant*, **32**: 251-258.

Zhou HX, Han B, Hou LM, *et al* (2016): Protective effects of hydrogen gas on experimental acute pancreatitis. *PLoS One*, Doi: 10. 1371/journal. Pone. 0154483.

Zhu WJ, Nakayama M, Mori T, *et al* (2011): Intake of water with high levels of dissolved hydrogen (H<sub>2</sub>) suppresses ischemia-induced cardio-renal injury in Dahl salt-sensitive rats. *Nephrol Dial transplant*, **26**: 2112-2118.

Zhu WJ, Nakayama M, Mori T, *et al* (2013): Amelioration of cardio-renal injury with aging in dahl salt-sensitive rats by H<sub>2</sub>-enriched electrolyzed water. *Med Gas Res*, **3**: 26.

Zhuang Z, Zhou ML, You WC, *et al* (2012): Hydrogen-rich saline alleviates early brain injury via reducing oxidative stress and brain edema following experimental subarachnoid hemorrhage in rabbits. *BMC Neurosci*. **13**: 47.

Zhuang Z, Sun XJ, Zhang X, *et al* (2013): Nuclear factor- $\kappa$ B/Bcl-XL pathway is involved in the protective effect of hydrogen-rich saline on the brain following experimental subarachnoid hemorrhage in rabbits. *J Neurosci Res*, 2013 Sep 16. doi: 10.1002/jnr.23281. [Epub ahead of print].

Zong C, Song G, Yao S, *et al* (2012): Administration of hydrogen-saturated saline decreases plasma low-density lipoprotein cholesterol levels and improves high-density lipoprotein function in high-fat diet-fed hamsters. *Metabolism*, **61**: 794-800.